A star (*) indicates that the Abstract deals with Apparatus and Instruments.

MAY, 1937.

GENERAL PHYSICS.

ADSORPTION.

1867. Adsorption and Overvoltage. S. v. Náray-Szabó. *Zeits. f. phys. Chem.* 178. *Abt. A.* 5. *pp.* 355–360, 1937.—It was shown by Butler that adsorbed H_2 formed a measurably lower negative voltage than gaseous H_2, the adsorption of the H_2 taking place during electrolysis. By the assistance of this observation several details connected with the overvoltage of H_2 are elucidated. Among the details discussed are the necessity for long kathodic polarisation before reproducible results can be obtained, the slow rise of the overvoltage on smooth Pt, the relationship between the quantity of H_2 adsorbed by the kathode and the overvoltage and the extremely low values obtained for Tafel's factor b on smooth Pt. F. J. B.

See also Abstracts 1894, 2172.

ATOMIC AND MOLECULAR STRUCTURE.

1868. Choice of Nuclear Statistics. T. Sexl. *Naturwiss.* 25. *pp.* 153–156, *March* 5, 1937.—Review of the methods available for determining the choice of nuclear statistics under the headings of (1) alternating intensities in the band spectra of diatomic molecules, (2) contribution of rotational energy to specific heats of gases, (3) scattering of identical particles. F. C. C.

1869. β-Interaction. G. Wentzel. *Helv. Phys. Acta,* 10. 2. *pp.* 107–111, 1937. *In German.*—It is probable that, in addition to the known process of β-transmutation, there are other nuclear transitions which lead to the emission of neutral pairs of light particles (electron and positron, or neutrino and antineutrino). The significance of such transitions for the theory of nuclear forces is discussed. R. P.

1870. Theory of the Deuteron: Proton-Neutron Interaction. T. Kahan. *Comptes Rendus,* 204. *pp.* 414–416, *Feb.* 8, 1937.—The forces of interaction between proton and neutron are of either the Majorana or Heisenberg type, *i.e.,* independent of, or dependent on, the relative directions of spin respectively. Arguments (mathematical) are adduced to the effect that in the deuteron interaction of both types coexist, that of Heisenberg type being only one-third as powerful as that of Majorana type. C. A. S.

1871. Photoelectric Cross-Section of the Deuteron. Katherine Way. *Phys. Rev.* 51. *pp.* 552–556, *April* 1, 1937.—Photoelectric cross-section curves for a Majorana-Heisenberg potential of the type $V = -V_0 e^{-r^2/a^2}$ and a velocity dependent potential determined by $J_0 = -(2B/a)e^{-(r+\rho)/a}$ are compared with a cross-section curve for a square hole Majorana force calculated by Breit, Condon and Stehn. In each case the values of the constants used are those which have been determined as the best for accounting for the binding energies of H^2, H^3, and He^4. Results show that the cross-section values for the first two potentials differ considerably from the third but very little from each other. A general formula for the area under the cross-section curve, which holds for exchange as well as for ordinary forces is derived. For exchange forces $\int \sigma(\nu) d(h\nu)$

$\cong(\pi e^2 h/2Mc)\ (1 + a\alpha)$ and this depends only on a, the range of interaction, α being defined by $\alpha^2 h^2/M = \epsilon$, the binding energy of the deuteron. The addition of a long range repulsive force to the velocity dependent interaction is found to decrease the cross-section for this potential type considerably. The classical equivalent of the velocity dependent potential operator is determined. AUTHOR.

1872. Intermediate Nucleus and Atomic Disintegration in Steps. W. D. Harkins. *Nat. Acad. Sci., Proc.* 23. *pp.* 120–131, *Feb.*, 1937.—The author claims priority for the view that, in nuclear disintegration, the bombarded nucleus and the projectile form, for some time a compound nucleus, which will then disintegrate with the emission of some other particle. This view is illustrated by a number of examples. [See also Abstract 419 (1937).] R. P.

1873. Resonance Process in the Disintegration of Boron by Protons. J. H. Williams, W. H. Wells, J. T. Tate and E. L. Hill. *Phys. Rev.* 51. *pp.* 434–438, *March* 15, 1937.—An experimental investigation of the efficiency of production of α-particles from B as a function of the energy of the bombarding protons is reported. Of the two established processes, ${}_5B^{11} + {}_1H^1 \rightarrow 3\,{}_2He^4 + Q_1$ and ${}_5B^{11} + {}_1H^1 \rightarrow {}_4Be^8 + {}_2He^4 + Q_2$, the second exhibits peculiarities in its efficiency curve whereas the first increases exponentially with proton energy. This irregularity is interpreted as the occurrence of a resonance process in the second disintegration, the resonance peak occurring at 180 kV. A discussion of the possible theoretical interpretations of the process is given. Absolute yields for a thick B target at various proton energies are given. AUTHORS.

1874. Nuclear Transformations of Boron by Slow Neutrons. O. Haxel. *Zeits. f. Physik*, 104. 7–8. *pp.* 540–548, 1937.—By means of a proportional counter of the type of Geiger and Zahn investigation was made of the α-radiation of B liberated by slow neutrons. In this way two α-particles and a group of Li particles were produced. The group was traced back to the production of an excited Li^7 nucleus. Farther, after a finite duration of life, examination was made of the B^{11} nucleus formed by the addition of the neutron to the B^{10} nucleus. The B^{11} nucleus is an intermediate product whose life duration is less than 1/20 sec. J. J. S.

1875. Formation of Helium in Substances Exposed to the Unfiltered Rays from ThB+C. P. L. Günther. *Zeits. f. phys. Chem.* 35. *Abt. B.* 5. *pp.* 331–342, 1937.—Using the sensitive quantitative methods developed by Paneth and by Günther for the estimation of small amounts of He, the formation of He in certain light substances such as CO_2, S, H_2O, paraffin and other C compounds is observed. The author is unable to account for the effect which is absent with heavier materials such as Hg, Sn and I. F. C. C.

***1876. Fast Corpuscular-Ray Apparatus and Transmutation Results. W. Bothe and W. Gentner.** *Zeits. f. Physik*, 104. 9–10. *pp.* 685–693, 1937.—Description of a van de Graaff apparatus for about 500 kV working potential. The main improvement consists in the shape of the top electrode, which is not a sphere, but a horizontal cylinder with rounded-off ends. In this way the discharge tube can be put immediately below the electrode while the ion source is accommodated inside the electrode. With this apparatus the γ-rays produced by bombarding F, Li, and B with protons are observed. The results confirm those of other observers, except for a resonance level for protons in Li at about 200 kV

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which had not been reported before. The excitation curve for α-rays from B is found to be very similar to that for γ-rays. R. P.

1877. Induced Radioactivity of Calcium. H. Walke. *Phys. Rev.* 51. *pp.* 439–445, *March* 15, 1937.—Ca activated by deuterons, was chemically separated as for Sc, Ca and K, the Sc portion showing much the greatest activity. This consisted of three portions with half lives of 53 ± 3 min., 4 ± 0·1 hrs., and 52 ± 2 hrs., produced by 5·4, 3·6 and 30 (×10^7) deuterons per atom, and probably corresponding with Sc^{44}, Sc^{43} and Sc^{41} respectively. The activity of the Ca portion is due to Ca^{45}, half life 2·4 ± 0·2 hrs., produced by 9·0 × 10^8 deuterons per atom. Ca also yields Sc^{43} when activitated by α-particles (2 × 10^5 per atom). Ca^{45} is also produced when Ca is activated by slow neutrons, or Ti by fast. The half period 14·5 hrs. produced when $CaCO_3$ is activated by neutrons is probably due to Na^{24}, certainly not to K^{43}. C. A. S.

1878. Isobares. W. A. Plotnikow. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 4. *pp.* 189–191, 1937. *In German.*—The 43 pairs of isobaric elements are discussed from the standpoint of Aston's rule, viz.—that in the majority of cases the atomic numbers of such elements are even and differ by two units, while the atomic weights are likewise even. It is now pointed out that 8 pairs are exceptions to this rule in that the difference is only one, but it is found that these 8 pairs exhibit the following regularity, viz.—that they can be divided into groups of 2 isobaric pairs in such a way that the isobare of the higher atomic number of the lighter pair is always an isotope of the isobare of the lower atomic number of the heavier pair. A procedure is then described for the construction of isobares which deviate from the Aston rule, and which is based on nuclear packing. The more general rule is then proposed, viz.—The atomic numbers of isobares differ by 2 or 1, and the latter obey the above regularity. H. H. Ho.

1879. Stable Isobares. D. R. Inglis and L. A. Young. *Phys. Rev.* 51. *pp.* 525–526, *March* 15, 1937.—A simpler method is given for arriving at the results obtained by Wigner [see Abstract 414 (1937)], which are also extended to include a more general case. C. A. S.

1880. Neutron Emission from Be when Bombarded by H, D, and He. R. Döpel. *Zeits. f. Physik,* 104. 9–10. *pp.* 666–671, 1937.—Observations of the radiation emitted from Be when bombarded with H, D, and He are described. No emission of neutrons when a bombardment of protons of energy up to 200 kV can be detected. Neutrons are detected when deuterons are used but it is pointed out that they could equally well be explained as the result of an interaction between the deuterons themselves. A bombardment of α-particles of energy up to 200 kV gives a yield of about one neutron per 10^{12} α-particles. J. E. R. C.

1881. Angular Distribution of Photo-Neutrons from Beryllium. T. Goloborodko and L. Rosenkewitsch. *Phys. Zeits. d. Sowjetunion,* 11. 1. *pp.* 78–82, 1937. *In English.*—Comparison of the number of photoneutrons ejected from Be by γ-rays in the direction of the latter with the number of those ejected in the perpendicular direction. Within the limits of experimental error it was found that the distribution of these photoneutrons does not depend on the direction. The effective cross-section for the scattering of Be photo-neutrons by Be was found to be 2·9 ± 0·5 × 10^{-24} cm^2. AUTHORS.

1882. Neutron-Deuteron Interaction. S. Kikuchi, H. Aoki and E. Takeda. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 687. *pp.* 195–204, *March*, 1937. *In English.*—A search was made for the γ-rays excited in D_2O bombarded with fast as well as slow neutrons. No positive effects could be observed. It is concluded that the upper limit of the cross-section for emitting γ-rays under the action of fast neutrons (2·4 eMV) is 0·037 times that for Cu ; *i.e.* about 1×10^{-26} cm², and that the cross-section for combining slow neutrons with ^2H to form ^3H must be smaller than $0{\cdot}2 \times 10^{-25}$ cm². The ability of D_2O to slow down neutrons was also investigated. Under our experimental conditions, no slow neutrons of C or A group created in D_2O could be confirmed. The efficiency was smaller than 1/27 of that for H_2O. It is shown that the result of Dunning and others [see Abstract 3719 (1935)] should be interpreted in another way. AUTHORS.

1883. Absorption of Slow Neutrons. S. Kikuchi, E. Takeda and J. Ito. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 43–52, *Jan.*, 1937. *In English.*—Measurements are made to test the assumption that the emission of γ-rays from elements bombarded with slow neutrons occurs simultaneously with the absorption of the neutrons. Firstly the relation between the target area for producing radio-elements by the capture process and that for producing γ-radiation is determined and it is concluded that the emission of the γ-ray quantum occurs simultaneously with the absorption of the neutron in the elements Al, V, Mn and Cu. Secondly the equilibrium radio-element activity is compared with the γ-radiation emitted during the bombardment, but the results are inconclusive. J. E. R. C.

1884. Back Scattering of Neutrons and Increased Neutron Concentration. H. Rausch v. Traubenberg and H. Adam. *Zeits. f. Physik*, 104. 5–6. *pp.* 442–447, 1937.—Experiments show that if a source of slow neutrons is enclosed in an iron box the density of neutrons in the box is about 3·3 times higher than it would be without the iron at a similar distance from the source. The increase produced by walls of paraffin or lead is much smaller than that produced by iron. R. P.

1885. Magnetic Scattering of Neutrons. J. S. Schwinger. *Phys. Rev.* 51. *pp.* 544–552, *April* 1, 1937.—The scattering of slow neutrons by atoms is considered, assuming that, in addition to the ordinary nuclear forces, there is a magnetic interaction between the neutron and the atomic electrons. It is found that the neutrons scattered from an unpolarised beam will be partially polarised in virtue of this magnetic interaction. Since the scattered intensity depends not only upon the intensity, but also upon the spin density of the incident beam, the polarisation thus produced can manifest itself by a second scattering. An expression is derived for the neutron intensity after double scattering from magnetised iron plates. Under optimum conditions, it is found that the scattered intensity with parallel orientation of magnetisations is 15 times that with antiparallel orientation. The partial polarisation of the scattered neutrons indicates that the undeviated neutron beam will also have a non-vanishing spin density. Expressions are derived for the intensity and spin density of a neutron beam after traversing a certain thickness of magnetised iron. These results are used in the discussion of three types of experiments for producing and detecting a polarised beam of neutrons. AUTHOR.

1886. Valency Electrons of Carbon in Organic Substances. O. Schmidt. *Zeits. f. Elektrochem* 43. *pp.* 238–246, *April*, 1937.—In the present paper a classification is given of the valency electrons of C into free and bound on analogy with similar considerations in metallic theory. It is shown that with organic compounds these two classes may be definite quite sharply, and the respective valency electrons are denoted as B- and A-electrons. This classification is then illustrated with respect to graphite. The A-electrons are next treated as confined within frames by high potential walls. Successive sections are devoted to B-electrons in polyvalent unions, mobile A-electrons, and fusion procedure in the chain of an unsaturated hydrocarbon. A fundamental difference between metals and high molecular organic compounds is found to lie in the fact that closed spaces are to land in the latter wherein are paired the valency electrons of 2- atoms. In unsaturated compounds there is a great difference in density distribution as compared with the uniformity in metals. H. H. Ho.

1887. Theory of Metallic Bond. Part IV. P. Gombás. *Zeits. f. Physik*, 104. 7–8. *pp.* 592–603, 1937.—The present investigation deals with the bonding of the alkaline earth metals. By means of a simplified statistical method, which was mainly developed in Part III [see Abstract 430 (1937)], it was found that the lattice energy is proportional to 1/R, and the compressibility to R^4, where R denotes the radius of the spherical element containing one ion in the stable equilibrium position. This result, which is to be regarded as a first approximation, has received satisfactory experimental confirmation. In addition it is shown, by means of the above method, that the most important lattice constants of the alkaline earth metals may be determined from purely theoretical considerations. The calculations were carried out for Ca, Si and Ba and the results found to agree excellently with the empirical constants. Finally the applicability of the method to the metals Cu, Ag, Au, Zn, Cd and Hg is discussed. The results have been derived without the assumption of any kind of arbitrary parameter. H. H. Ho.

1888. Structure of Derivatives of Fluorene and Fluorenone. E. D. Hughes, C. G. le Fèvre and R. J. W. le Fèvre. *Chem. Soc., J. pp.* 202–207, *Feb.*, 1937.—Dipole moment determinations are recorded for fluorene and fluorenone and for several of their derivatives. An attempt is made to determine the spatial configuration of the fluorene molecule by comparing the observed results with these calculated on the basis of assumed configurations. Although certain structures are excluded the comparison leads to no definite conclusion about the molecular structure of fluorene. J. I.

1889. Molecular Structure. *J. Phys. Chem.* 41. *pp.* 1–173, *Jan., and pp.* 175–324, *Feb.*, 1937.—A symposium consisting of 26 papers, preceded by an Introduction and followed by a Discussion.

"Introduction," by **H. L. Johnston** (*pp.* 1–4).—Contains a review of the types of information which can be obtained from studies of molecular spectra, X-ray diffraction and dipole moments.

"Solved and Unsolved Problems in the Spectra of Diatomic Molecules," by **R. S. Mulliken** (*pp.* 5–45).—The following topics are discussed: band organisation and vibrational energy levels, band structures and rotational and electronic levels, Raman effect, continuous diatomic spectra, potential energy curves, carriers of band spectra, applications of band spectra, nuclear manifestations and electronic structures of molecules.

"Spectra of Diatomic Molecules of Elements of the Fifth Group," by **G. M. Almy** (*pp.* 47–58).—The available data for the electronic states of N$_2$, P$_2$, PN, AsN, As$_2$, Sb$_2$ and Bi$_2$ are summarised and correlated.

"Electronic Energy Transfers between Iodine and Other Molecules," by **J. R. Bates** (*pp.* 57–59).—The quenching efficiencies in I_2 fluorescence can be accounted for by assuming that the deactivation results in dissociation.

"Intermolecular Forces Responsible for Pressure Broadening of Band Lines," by **W. W. Watson** (*pp.* 61–65).—Data for the relationship between pressure broadening of band lines and molecular dipole moments are reviewed and possible intermolecular effects are discussed.

"The Puzzle of Rare Earth Spectra in Solids," by **J. H. van Vleck** (*pp.* 67–80).—The sharp lines in rare earth spectra are forbidden lines. They probably orginate from various causes such as quadrupole radiation, magnetic dipole radiation, and radiation created by certain crystalline fields. There is evidence of interplay between vibration and electronic motion.

"Comparison of Some Ultra-Violet Absorption Spectra of Polyatomic Molecules with Those of Diatomic Molecules," by **W. A. Noyes, Jr.** (*pp.* 81–89).—The electron states of CO and the CO-group are contrasted. Agreement between their frequencies does not necessarily mean similarity in types of bond. Some other characteristic bonds are also considered.

"Ultra-Violet Absorption Spectra of Diborane," by **E. Blum and G. Herzberg** (*pp.* 91–95).—Two regions of continuous absorption, commencing respectively at 2200 and 1700 Å, are observed above 1550 Å. The possible electronic configurations of the two excited states involved are discussed.

"Photochemistry of Polyatomic Molecules," by **J. Franck and K. F. Herzfeld** (*pp.* 97–107).—Photosynthesis is discussed. In photochemical reactions of polyatomic molecules able to emit fluorescent light, the thermal energy can contribute to a much greater account than previously assumed.

"Crossing of Potential Surfaces," by **E. Teller** (*pp.* 109–116).—A discussion of the types of crossing of potential surfaces of polyatomic molecules and their significance.

"Nature of the Hydrogen Bond. Part II. Rôle of Resonance," by **A. Sherman** (*pp.* 117–122).—A H-bond may be defined as one whose energy is derived from resonance energy, the electron of the H atom being part of the resonating system. Other definitions are criticised. [For Part I see Abstract 3939 (1936).]

"Photographic Infra-Red Spectrum of Methylacetylene and the C-C Single Bond Distance," by **G. Herzberg, F. Patat and H. Verleger** (*pp.* 123–132).—A band at 10304 Å is photographed. It has P, Q and R branches, and shows that the four atoms, C-C≡C-H, are in a straight line. The moment of inertia in the ground state is $97 \cdot 15 + 10^{-40}$ gm.cm.^{2}, and the value 1·462 Å is deduced for the C-C single bond distance.

"Raman Spectra of Amino Acids and Related Compounds, Part II," by **J. T. Edsall** (*pp.* 133–141).—Raman spectra of thiourea, the guanidonium and methyl guanidonium ions, methyl urea and thioacetamide are recorded. Urea and thiourea have a twofold axis, and the guanidonium ion is found to possess trigonal symmetry. It is suggested that the formate ion should have twofold symmetry. [For Part I see Abstract 717 (1936).]

"Raman Effect of Deuteroammonia," by **G. Glockler and F. T. Wall** (*pp.* 143–147).—Results of Raman effect measurements agree with those from the infra-red spectrum. A method of allocating types of motion of atoms to the fundamental frequencies is illustrated.

"Entropy and Symmetry of the Benzene Molecule," by **R. C. Lord, Jr. and D. H. Andrews** (*pp.* 149–158).—A recalculation of the symmetry number of benzene on the basis of recent spectroscopic data leads to the value 12.

"Nomenclature and Symbols for Polyatomic Molecules," by **R. S. Mulliken** (*pp.* 159–173).—Proposals are made for a unified system of nomenclature for the electronic states of polyatomic molecules, including isotopic molecules and predissociation and perturbation types.

"Some Aspects of Investigations of Molecular Structure of Organic Compounds," **G. B. Kistiakowsky** (*pp.* 175–183).—A discussion of internuclear distances, bonding and resonance energies in organic molecules.

"Structure of the Fluorochloromethanes," **L. O. Brockway** (*pp.* 185–195).—The structural formulae of halogen derivatives of simple hydrocarbons are discussed in the light of measurements of carbon-halogen distances.

"Ionisation and Dissociation of Molecules by Electron Impact," **W. Bleakney, E. U. Condon and L. G. Smith** (*pp.* 197–208).—Applications of the mass spectrograph to investigations of molecular structure (particularly to CH_4) are described.

"Bond Moment and Electronegativity," **C. P. Smyth** (*pp.* 209–219).—Dipole moments associated with typical groups are collected and are used to calculate the moments of a number of bonds in the light of Pauling's electronegativity scale and factors contributing to the moments.

"Molecular Structure and van der Waals Forces," **E. Mack, Jr.** (*pp.* 221–231).—The structure of benzene, films and surface energy, and the melting-point behaviour of molecules with double bonds are discussed from the aspect of van der Waals forces.

"Quantum Theory of Valence," **S. Dushman and F. Seitz** (*pp.* 233–248).—All interatomic cohesion energy arises from electrostatic forces, and this energy can be calculated for some simpler cases.

"Theory of the Liquid State," **H. Eyring and J. Hirschfelder** (*pp.* 249–257).

"Photochemical Behaviour of the Aldehydes," **G. K. Rollefson** (*pp.* 259–265).—Several decomposition mechanisms are necessary in order to account completely for the observed photochemical behaviour of acetaldehyde.

"Reaction between Bromosuccinate Ion and Thiosulphate Ion," **F. A. Long and A. R. Olson** (*pp.* 267–281).—This reaction is studied by kinetic and polarimetric methods. The results are in accordance with Brönsted's theory.

"Reaction of Oxygen and Hydrogen at Low Pressures," **W. H. Rodebush** (*pp.* 283–291).

"Absorption Spectra as a Test for Free Radicals," **O. Oldenberg** (*pp.* 293–297).—Absorption measurements are applied to the determination of OH radicals.

Discussion (*pp.* 299–324). C. B. A.

1890. Distribution of Molecular Weights in Macromolecular Substances. H. Dostal and H. Mark. *Faraday Soc., Trans.* 33. *pp.* 350–353, *Feb.*, 1937.—The mean molecular weights of macromolecular long-chain substances, which are stated always to be mixtures of molecules of different dimensions, may be determined either by Staudinger's method based on viscosity measurements or by estimation of osmotic pressure. The mean values so obtained will differ, however, unless the system is homogeneous. A method is outlined whereby this difference may be employed to determine the molecular weight distribution. L. V. C.

1891. Atomic Radii from Parachor Data and from Electron Diffraction Data. N. S. Bayliss. *Am. Chem. Soc., J.* 59. *pp.* 444–447, *March*, 1937.—Revised atomic parachor constants are calculated from existing parachor data. On the assumption that atomic parachors are a measure of atomic volume, and that the volume of the C atom is that of a sphere of radius 0·77 Å, it is found that one parachor unit = 0·210 Å.^{3} By adopting simple atomic models, this relation is then used to calculate bond radii for quadrivalent atoms and packing radii for univalent atoms that are in good agreement with existing data. AUTHOR.

1892. Atomic Weight of Carbon. Part II. G. P. Baxter and A. H. Hale. *Am. Chem. Soc., J.* 59. *pp.* 506–509, *March*, 1937.—It seems unlikely that the final value would be altered materially by continuance of the experiments. Of the four hydrocarbons investigated, one, pyrene, proved incapable of being purified by any method that could be devised.The other three yielded identical results for carbon, whether they had been initially separated from coal tar, or synthesised, from a simple coal tar product in two cases(chrysene and anthracene), from a natural product in the third (triphenylbenzene). The average atomic weight of C obtained by combustion of chrysene, triphenylbenzene and anthracene, 12·010, may therefore be taken as a fair outcome of this method of attack. [For Part I see Abstract 2487 (1936).] AUTHORS.

See also Abstracts 1912, 1989, 2021, 2026, 2120, 2128, 2130, 2131, 2133, 2212, 2227, 2236, 2247.

COLLOIDS.

1893. Electrochemical Nature of Cellulose Solutions. Alma Dobry. *Comptes Rendus*, 204. *pp.* 861–863, *March* 15, 1937.—In general colloids soluble in water conduct electricity, those soluble in benzene do not. The intermediate group, soluble in neither, but only in certain organic solvents of high dielectric constant, such as acetone and methanol, *e.g.*, some cellulosic ethers, is examined. Of these di- and tri-nitrocellulose show slight conductivity when dissolved in acetone, less as their molecular weight is greater. Cellulose acetate appears to be sometimes conducting, sometimes not. C. A. S.

1894. Theory of Rapid and Slow Coagulation. P. N. Pawlow. *Kolloid Zeits.* 78. *pp.* 307–310, *March*, 1937.—In rapid coagulation, the particles unite by contact of their liquid adsorption envelopes. The attraction radius of Smoluchowski is consequently always greater than the diameter of the particle. The velocity of the rapid coagulation of a monodisperse sol depends on the particle radius, and since $h = (A/2) - r$, where h is the thickness of the adsorbed liquid envelope, it follows that for fine particles the velocity is greater than for coarse ones. The velocity constant is connected with the ζ-potential of the particle by the equation: $k = 4\pi ADe^{-\zeta F/R\theta}$. H. H. Ho.

1895. Kinetics of Aerosol Coagulation. L. V. Radushkevich. *Acta Physicochimica*, 6. 2. *pp.* 161–182, 1937. *In English.*—This paper gives the results of experiments in which the detaining of smoke particles during the flow of NH_4Cl aerosol along glass capillaries is studied. The results obtained are best explained by the hypothesis, that the smoke passing along the vertical capillaries with a small velocity diffuses towards the walls. This diffusion follows Townsend's theory, developed for the diffusion of gaseous ions in capillaries. New data are given supporting the statement that Smoluchowski's theory of coagulation is applicable to smokes homogeneous in early stages and of the type of NH_4Cl smoke, obtained by volatilisation in an air stream. Correspondence of this theory with the data was experimentally observed during 1 – 1½ hr. A new method of studying aerosol coagulation is suggested and realised, on the basis of Townsend's method. AUTHOR.

1896. Electroosmotic Circulation in Closed Vessels. P. White. *Phil. Mag.* 23. *pp.* 811–823, *April*, 1937. *Supplement.*—Two sources of error which may arise in electrophoretic measurements can be eliminated if the observations are interpreted in the light of the following modifications to v. Smoluchowski's theory of electroosmotic circulation. (1) The parabola representing the distribution of electroosmotic velocity in a closed rectangular cell is not necessarily situated symmetrically in the cell. When it is found to be displaced the electrokinetic velocities can be calculated by the formulæ given. The asymmetry arises from inequality of electroosmosis at opposite faces of the cell. It cannot be caused by convection as long as the distribution curve is a true parabola, nor can it usually be attributed to buoyancy or sedimentation of the particles. (2) In using a slit ultramicroscope an error may be introduced by working near the face of the chamber through which the illuminating beam enters. This error (which is due to electroosmotic drag at the face in question) is less than 1 % of the electroosmotic velocity when observations are made at a distance from this face greater than 1·5 times the depth of the chamber. AUTHOR.

1897. Electrophoresis Measurement by the Ultramicroscope. T. B. Lane and P. White. *Phil. Mag.* 23. *pp.* 824–828, *April*, 1937. *Supplement.*—The usual method of measuring electrophoresis by determining the velocities of suspended particles under the ultramicroscope at one of the levels given by v. Smoluchowski has been found to be in error by amounts which vary irregularly and may exceed 30 % of the true value. This discrepancy is due to the fact that electroosmosis at the top face of the containing vessel is not, in practice, equal to that at the bottom face, as v. Smoluchowski assumed. The error can be eliminated by measuring at *both* the prescribed levels. The true electrophoretic velocity is the arithmetic mean of the two values so obtained. A series of experiments on a graphite sol gave results with a probable error of 20·4 % when treated in the usual way, but of only 2·3 % when averaged in the manner suggested. AUTHORS.

1898. Particle Size and Optical Properties of Emulsions. E. D. Bailey, J. B. Nichols and E. O. Kraemer. *J. Phys. Chem.* 40. *pp.* 1149–1155, *Dec.*, 1936.—A method is given for converting the "weight-optical" distribution of a suspension as determined by the Svedberg ultracentrifuge into a true weight distribution of the suspension. L. V. C.

***1899. Preparation, Characterisation and Use of Membranes. E. Manegold.** *Kolloid Zeits.* 78. *pp.* 129–148, *Feb.*, 1937.—An account of technical improvements in plane and in open and closed tubular membranes of cellulose and cellulose esters, covering the following points (*a*) general methods of preparation, (*b*) methods of stabilisation, (*c*) characterisation by thickness, water permeability, pore volume (pore radius computed by two distinct methods); new apparatus described includes (*a*) darcymeters (membrane permeability meters) for gases and for liquids, (*b*) a universal apparatus for membrane investigations, as for example in dialysis and electrodialysis, in filtration and electrofiltration and in osmosis and electrical endosmose. The open and closed tubular membranes described have conical openings to fit standardised ground-glass joints. L. V. C.

***1900. Apparatus for Electrophoretic Analysis of Colloidal Mixtures. A. Tiselius.** *Faraday Soc., Trans.* 33. *pp.* 524–531, *April*, 1937.—Some improvements in the experimental arrangement for electrophoresis are discussed, with special attention to the study of mixtures. It is shown that a very considerable increase in the applied potential gradient can be obtained by changing the shape of the U-tube, and, above all, by keeping the electrophoresis tube at a temperature in the neighbourhood of the density maximum for water (+ 4° C.), thus greatly reducing the risk of heat convection currents. A modification of an earlier construction of electrophoresis apparatus is described, in which regard has been given to these points. The new apparatus has also provision for taking out samples of the separated fractions. The optical observation of the boundaries is made by an improved method depending upon refractive index (Töpler's *schlieren* method). For difficult separations large electrode vessels can be used, and a compensation arrangement, making it possible to obtain a large separation volume even if the components migrate in the same direction. AUTHOR.

See also Abstracts 1890, 1955, 2058, 2151, 2239.

CRYSTAL STRUCTURE AND PROPERTIES.

1901. Crystal Polymorphism. M. J. Buerger and M. C. Bloom. *Zeits. f. Krist.* 96. 2-3 *pp.* 182–200, 1937. *In English.*—An account is given of the development of ideas regarding polymorphism and a new theory of polymorphism is outlined, which is based on the energy of polyatomic groups, such as coordination groups, ionic groups and molecular groups in the crystal structure. Such groups are known as clusters and the theory assumes that the physical state of a crystalline compound depends on the heat vibration modes of these clusters. The cluster vibration modes are similar to the vibration modes of polyatomic molecules, except that the "outer" modes are not necessarily excluded, and the symmetry position occupied by the cluster depends on the symmetry of its vibration mode. As the temperature is increased, vibration modes of increasing kinetic energy are called forth, the symmetry of the cluster must alter, and the compound assumes a series of states of increasing configuration energy. J. T.

1902. Vibrations of a Face-Centred Cubic Lattice. C. Strachan. *Phil. Mag.* 23. *pp.* 590–597, *April*, 1937.—The author derives expressions for a face-centred cubic lattice giving the sum over all normal modes of vibration of the function which gives the probability that the oscillator corresponding to a normal mode will emit or absorb a quantum of energy. J. I.

1903. Transformations of Metals on Heating in a Vacuum or Gases. J. J. Trillat and S. Oketani. *J. de Physique et le Radium,* 8. *pp.* 59–66, *Feb., and pp.* 93–98, *March*, 1937.—A detailed account is given of the electronic examination of the changes in a pure Au film resulting from heating to various temperatures up to 900° in various gases or a vacuum [see Abstract 33 (1937)]. The hexagonal lattice ("B" diagram) formed by superficial fluidity gradually disappears above 600° and is replaced by the normal one of recrystallised Au. 975/1000 Au (15 Ag + 10 Cu) behaves similarly in inert gases or a vacuum, but in O_2 gives a new diagram ("O"), due to "interstitial solid solution of O intermediate between the adsorption of Langmuir and true combination," which disappears in five years at ordinary temperatures, in a few hrs. at 500°. Pure Ag behaves similarly. Pt, Cu and Al show no change in a vacuum or inert gas, but Cu and Al in O give diagrams indicating oxidation [see Abstracts 4074 (1935), and 2866 (1936)]. C. A. S.

1904. Structural Investigation of Roughness and Grain-Size by Electron Diffraction. W. Papsdorf. *Ann. d. Physik,* 28. 6. *pp.* 555–568, *March,* 1937.—Ag films of various thicknesses were evaporated *in vacuo* on different substrates and the roughness deduced from the corresponding reflection and transmission patterns. It was found that for equally thick Ag films, the surfaces were smoothest on quartz and successively rougher on glass, mica, rock-salt and collodion substrates. This effect is attributed to the fact that with a rough substrate the electron beam will pass through the metal crystals formed on projections and therefore sharp rings will be observed even with very thin films. The sharp ring patterns occasionally obtained in reflection from long-chain hydrocarbons are also explained as being due to the transmission of the electron beam through crystals projecting above the general surface. It is suggested that the sharpness of the diffractions in reflection patterns from evaporated metal films is determined primarily by the surface roughness, and therefore great care should be taken in deducing crystal size, in view of the pronounced substrate effect observed. No diffraction maxima were observed at the smooth surfaces of pure Hg and amorphous substances. A. G. Q.

1905. Primary Oxide Film on Iron. H. R. Nelson. *J. Chem. Phys.* 5. *pp.* 252–259, *April,* 1937.—It is shown by electron diffraction that the invisible air-formed oxide film on electrolytic and Armco iron is structurally identical with Fe_3O_4, the $[\sqrt{2}10]$ direction in the oxide crystals being parallel to the [111] direction in the iron. Evaporated films of electrolytic iron were prepared in the diffraction camera, and patterns obtained before and after exposure to air show that Fe_3O_4 forms rapidly in dry air at room-temperatures. The factors affecting the sensitivity of the electron diffraction method of examining thin films on metals are discussed. A. G. Q.

1906. Oxide Films on Metal Surfaces. Part II. Fe, Cr, Ni and Their Alloys. S. Miyake. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 684. *pp.* 161–173, *March,* 1937. *In English.*—Oxide films formed at high temperatures on Fe, Cr, Ni and their important alloys are studied by means of kathode-ray diffraction. (1) An α-Fe_2O_3 film was observed on an Fe surface on heating above 250° C., but at lower temperatures (200° C.) Fe_3O_4 is presumably formed. Fe_3O_4 was also observed in the underlying layer beneath the uppermost α-Fe_2O_3 film. (2) On Ni and Cr were found respectively NiO and Cr_2O_3. (3) On surfaces of Fe–Al alloys (Al 2—15 %) and Fe–Ni alloys (Ni 3—36 %) no oxides other than α-Fe_2O_3 were detected. (4) On stainless steels were formed $FeCr_2O_4$ coexisting with Cr_2O_3 or a solid solution of Cr_2O_3–Fe_2O_3. On nichrome was formed a pure $NiCr_2O_4$-film. (5) On Cu–Ni alloys (Ni 7—70 %) was found only a CuO film but a formation of NiO film beneath the uppermost layer was suggested. [For Part I see Abstract 4471 (1936)]. AUTHOR.

1907. Lattice Spacing of Iron-Nickel Alloys. A. J. Bradley, A. H. Jay and A. Taylor. *Phil. Mag.* 23. *pp.* 545–567, *April,* 1937.—The lattice spacing of 35 Fe-Ni alloys are determined after slow cooling to room-temperature. The lattice spacings of the Fe-rich body-centred cubic alloys increase from 2·8605 Å for pure Fe to 2·8644 Å for 5·7 atomic % of Ni. In the two-phase region the lattice spacing is 2·8635 Å. The lattice spacings of the face-centred cubic Ni-rich alloys increase from 3·5169 Å for pure Ni to a maximum of 3·5878 Å at 38·69 atomic % of Ni and then fall to 3·5741 Å at 28 atomic % of Ni. This is the position of the phase boundary after slow cooling. The spacing change is linear from pure Ni to 78 % Ni, and thence to 45 % Ni. The break at 78 % Ni corresponds approximately to the composition of the high permeability alloy "permalloy." In this neighbourhood the values are less regular then elsewhere. The face-centred cubic alloys are also examined after quenching from 700°, 800° and 900°. The lattice spacings are found to be different from those in the slow cooling experiments, being on the whole decidedly higher. It is thought that this behaviour is connected with the magnetic properties of the alloy. AUTHORS.

1908. X-Ray Study of the Al-Cr System. A. J. Bradley and S. S. Lu. *Inst. of Metals, J.* 60. [18 *pp.*] 1937. *Advance Copy.*—Powder photographs are taken in a 9 cm. camera with Cr radiation and V filter to remove Kβ. The diagram deduced is very complex, as many as nine phases existing after slow cooling; and two additional phases after quenching above 1000° C. All alloys in the system give very similar photographs and the existence of the 110 line in all may be explained by the Jones-Brillouin theory [see Abstracts 1690 (1934) and 39 (1935)]. D. R. H.

1909. Alloy Phases with Fluorspar Structure. E. Zintl, A. Harder and W. Haucke. *Zeits. f. phys. Chem.* 35. *Abt. B.* 5. *pp.* 354–362, 1937.—The compounds formed by Au and Pt with Al, Ga and In are examined as part of an extended examination of intermetallic compounds in general [see Abstract 32 (1937)]. $PtGa_2$, $PtIn_2$, $AuGa_2$, $AuIn_2$ are prepared by heating the constituent metals *in vacuo* in quartz tubes. Owing to the exothermic nature of the synthesis, a white heat is attained. The alloys are homogenised at 1100–1100° C. for some hours, powdered in N_2, annealed at 200–400° C *in vacuo* and rapidly cooled to avoid atomic rearrangement. $PtAl_2$ is prepared similarly, in a sintered Al_2O_3 tube glazed in the oxy-acetylene flame, since Al attacks SiO_2, at a temperature approaching the melting point of Pt. Values of a deduced are: $AuGa_2$ (bluish) 6·063 Å, $AuIn_2$ (bluish) 6·502, $PtAl_2$ (yellow) 5·911, $PtIn_2$ (coppery) 6·353, compared with 6·00 previously determined for $AuAl_2$ (blue). The CaF_2 structure is definitely established by comparison of observed and calculated values of intensities. It is concluded that compounds without an anion-forming element rarely crystallise in the fluorspar lattice and in these exceptional cases the structure seems to be associated with some peculiarity of the component metals themselves. D. R. H.

1910. Structure of Heteropolyacids and their Salts. Part IV. O. Kraus. *Zeits. f. Krist.* 96. 4. *pp.* 330–335, 1937.—The triclinic Fe silicotungstate has a 19·11, b 22·50, c 23·92, α 87° 55′, β 105° 57′, γ 92° 25′. The density being 4·414 the hitherto accepted formula $Fe_4(SiW_{12}O_{40})_3 \cdot 60H_2O$ gives no satisfactory number of molecules to the unit cell. A new analysis agrees with $FeHSiW_{12}O_{40} \cdot 20H_2O$, of which the unit cell contains 8 molecules; space group C_1. The corresponding Al salt, is isomorphous. Comparison of the four Fe silicotungstates with 30, 28, 24 and 20 H_2O, shows that although respectively cubic, trigonal, trigonal and triclinic, the dimensions of the unit cells are closely similar, all possessing a diamond-like structure, while the H_2O groups may be regarded as an independent kation-like structure determining the system of the whole crystal. [For Part III see Abstract 3426 (1936)]. C. A. S.

1911. Structure of β-Carotene. W. H. Taylor. *Zeits. f. Krist.* 96. 2-3. *pp.* 150–154, 1937. *In English.*—The crystals are monoclinic with unit cell dimensions as follows: $a = 7{\cdot}75$ Å, $b = 9{\cdot}5$ Å, $c = 25{\cdot}0$ Å, $\beta = 105°$; 2 mol. per unit cell, space group $= C_{2h}^5 - P2_{1/c}$. The structure factors of the observed planes are given in absolute units. The probable molecular arrangement in the cell is discussed. J. I.

1912. Isotope Effect in Hydrogen and Hydroxyl Bonds. J. M. Robertson and A. R. Ubbelohde. *Nature,* 139. *pp.* 504–505, *March* 20, 1937.—The effect of substituting D for H on the intermolecular bonds of oxalic acid is examined by X-ray methods. A small expansion of the lattice occurs, mainly in the direction of the D bonds, an effect which throws light on the mechanism of the H bond, and promises to be of value in locating certain types of H linkage in complex structures.

1913. Relative and Absolute Spatial Configuration of Isomorphous, Optically-Active Complex Salts. Part II. F. M. Jaeger. *K. Akad. Amsterdam, Proc.* 40. 2. *pp.* 108–116, 1937.—The author gives the results of an investigation of the optical-activity of complex tridiaminosalts of trivalent Co, Cr and Rh. The determined spatial configurations of these salts are summarised in a table. [For Part I see Abstract 1462 (1937)]. J. I.

1914. Structure of Complex Salts of Racemic and Optically-Active Cyclohexanediamines with Trivalent Cobalt and Rhodium. Parts II and III. F. M. Jaeger and L. Bijkerk. *K. Akad. Amsterdam, Proc.* 40. 2. *pp.* 116–123, *and* 40. 3. *pp.* 246–258, 1937.—The preparation and optical-activity of the above compounds are described. Details are also given of their crystal form and optical activity. [For Part I see Abstract 1463 (1937)]. J. I.

1915. Twin Formation in Calcite. Part II. D. B. Gogoberidse and L. R. Nakaschidse. *Phys. Zeits. d. Sowjetunion,* 10. 6. *pp.* 820–825, 1936. *In German.*—It is shown that twin crystals of calcite possess in addition to the normal calcite cleavage a secondary cleavage in the plane of twinning. This appears to be due to strain set up by the twinning. When pressure is applied to the twins they can be made sufficiently uniform to cause this secondary cleavage to disappear [see Abstract 3747 (1935)]. J. I.

1916. Mixed Crystals in System $KClO_3$–$KMnO_4$. H. Seifert. *Zeits. f. Krist.* 96. 2-3. *pp.* 111–149, 1937.—The problem of the growth of regular and anomalous mixed crystals is investigated with particular reference to the above system. The author discusses in detail the significance of this system in the general theory of mixed crystal formation. J. I.

1917. Crystallisation in an Electric Field. W. Rix. *Zeits. f. Krist.* 96. 2-3. *pp.* 155–181, 1937.—A comprehensive investigation of the phenomena occurring during crystallisation in an electric field is described. Among other results it is found that crystal nuclei are always due to the presence of foreign grains. In the presence of these grains the number of crystal nuclei is doubled in a field of about 1500 V/cm. J. T.

1918. Reduction of Copper Halides by Hydrogen. K. Huber. *Zeits. f. Krist.* 96. 4. *pp.* 287–310, 1937.—The author discusses the principles underlying the formation of Cu when its halogen salts are reduced by H_2. Experiments are described in which thread-like crystals of Cu are obtained by allowing a stream of N_2 laden with the Cu salt vapour to impinge on a plate (glass, Cu or Ag) in an atmosphere of H_2, the reaction taking place at a high temperature. Reduction is also carried out by heating the salts in a boat in a stream of H_2. J. I.

1919. Active Surface of Crystalline Powders. L. Imre. *Faraday Soc., Trans.* 33. *pp.* 571–583, *April*, 1937.—One explanation of crystal growth is that it is due to the addition of 2-dimensional nuclei to complete lattice planes by successive adherence (adsorption) of individual atoms on the boundaries of "active spots." Experiments are described to determine the numbers (z) of these spots, and the proportion they bear to the whole surface (z/X), (*a*) by direct measurement of the adsorption of $PbNO_3$ on PbI_2, $PbSO_4$ (two preparations, A and B) and $PbCrO_4$; and (*b*) by measuring the incorporation velocity of Pb^{++} ions in the surface of the same compounds; using ThB as indicator. Method (*a*) gives for z/X 1, 1, 0·15 and 6·67 ($\times 10^{-2}$), and (*b*) 0·2, 1·3, 0·9 and 47 ($10 \times^{-2}$) respectively for PbI_2, $PbSO_4$ (A and B), and $PbCrO_4$. C. A. S.

1920. Kinetics of Plastic Deformation of Crystals. M. Kornfeld. *Phys. Zeits. d. Sowjetunion,* 10. 5. *pp.* 605–617, 1936. *In German.*—A method for the investigation of the kinetics of the plastic deformation of crystals is indicated and therewith a general definition of the plastic characteristics of a crystal is given. A statement is made of provisional experimental results which demonstrate the nature of the method described. J. J. S.

***1921. Universal X-Ray Photogoniometer. R. B. Hull and V. Hicks.** *Zeits. f. Krist.* 96. 4. *pp.* 311–321, 1937. *In English.*—A compact apparatus for making Laue, rotation, and Schiebold-Sauter photograms, without the intermediate transfer of the crystal, has been constructed. Back-reflection photograms may also be made. An accurate horizontal scale and verniers, combined with a microscope which may be used as an autocollimating telescope, facilitates the adjustment of the crystal and permits interfacial angle measurements. All essential parts are adjustable with respect to the goniometer axis. The adjustment and the use of the apparatus are briefly described. AUTHORS.

See also Abstracts 1887, 2012, 2152, 2170, 2253.

DENSITY.

1922. Supposed Allotropy of Liquid Benzene. E. Cohen and J. S. Buij. *Zeits. f. phys. Chem.* 35. *Abt. B.* 4. *pp.* 270–284, 1937.—Contrary to the views of Menzies and Lacoss and others it is experimentally shown that liquid benzene does not show allotropic forms when examined with respect to density between 20° and 60° and specific heat between 8° and 24°. J. K.

***1923. Apparent Molar Volumes of Dissolved Electrolytes. W. Geffcken, A. Kruis and L. Solana.** *Zeits. f. phys. Chem.* 35. *Abt.* B. 5. *pp.* 317–330, 1937.—The apparatus with which previously published measurements [see Abstract 5389 (1936)] were made is here described in detail. It consists of a special form of dilatometer whereby the volume changes accompanying the progressive mixing of two liquids can be rapidly and conveniently determined with an accuracy of ± 0·0002 cc., which corresponds to ± 1 unit in the sixth decimal place in density determinations. The precautions to be observed and the corrections to be applied in using the apparatus are discussed. As an example of the performance obtained results are given for four series of determinations upon aqueous NaBr solutions diluted in successive steps from 6·6 to 0·2 *N*. L. A. W.

See also Abstracts 1970, 2030, 2146, 2168, 2186, 2187, 2238.

DIFFUSION AND OSMOSIS.

1924. Diffusion Equation. P. S. Epstein. *Nat. Acad. Sci., Proc.* 23. *pp.* 94–98, *Feb.*, 1937.—Kolmogoroff recently published [*Math. Ann.* 104, *p.* 415, 1931] a mathematically elegant account of what might be called the general theory of diffusion. The main results of the analysis were two differential equations for transition probabilities, the first of which contained as its independent variables, the initial parameters of the transition probability and had an analytical form resembling the ordinary diffusion equation, the second (depending on the final parameters) had a form unfamiliar to the physical. The puzzling asymmetry of the two equations, as to whose physical reasons the author gave no hint, is now discussed, and it is shown that the second equation can be obtained from the first, the asymmetry being an immediate consequence of the second law of thermodynamics. Kolmogoroff's equations are then shown to be more general than the equation of diffusion and to include the case of transition probabilities which are inhomogeneous in time. H. H. Ho.

1925. Diffusion in Solid Alloys. R. F. Mehl. *J. of Applied Physics,* 8. *pp.* 174–185, *March,* 1937.—A critical review from the theoretical and physical aspects, with special reference to recent work, under the following headings:—1. General. 2. Methods; Fick's law. 3. Ideal cases. 4. Complications; grain boundaries. 5. Physics; van Liempt equation. 6. Diffusion data. 7. Alloys of Pb. 8. Alloys of Cu. 9. Alloys of Ag. 10. Alloys of Ag and Au with Cu, Pd, Pt, Ni. D. R. H.

1926. Explanation of Osmosis. A. Thiel. *Zeits. f. phys. Chem.* 178. *Abt. A.* 5. *pp.* 374–388, 1937.—It is argued on various grounds that osmotic pressure should not be regarded as a pressure in the solution but as a tension in the solvent necessary to achieve equality of vapour pressure, and thus to prevent the passage of solvent through the membrane. By the use of the hypsometric formula for the pressure of the vapour column in capillary rise phenomena, a simple derivation of the thermodynamically correct expression for the osmotic pressure can be obtained. The properties of a boundary system are deduced for a membrane, and it is inferred that dissolved substances of a non-volatile nature cannot produce a thermal pressure at the membrane. It is best to regard the permeation of solvent as taking place in a state of molecular dispersion. Filtration and ultra-filtration can be brought into simple relation with osmosis phenomena. P. H. B.

1927. Individuality of the Osmotic Behaviour of the Alkali Carbonates. F. Ender. *Zeits. f. Elektrochem.* 43. *pp.* 234–238, *April,* 1937.–The parallelism found by Fajans [see Abstract 3232 (1927)] for the gradation on the one hand of osmotic coefficients and on the other of solubility, heats of solution, and tendency to hydrate formation, was confirmed previously, for the alkali halides, and has now been extended to alkali salts with divalent anions in order to establish how the second stage of dissociation is related to the osmotic behaviour. For this purpose a comparison has been made of the freezing point depressions of aqueous potassium and sodium carbonate solutions, from which it appeared that carbonation throughout the entire range of concentration investigated behaved analogously to that of hydroxyl and fluorine ions. Experimentally, the cryoscopic methods and apparatus previously used [see Abstract **1701 (1931) 930 (1934)**] have been improved and full details are included. The concentration determinations have been based on conductivity instead of interferometric procedure, and the thermopile for the freezing-point measurements has also been greatly improved with respect to sensitivity and stability. H. H. Ho.

See also Abstracts **1890, 1895, 1899.**

ELASTICITY AND PLASTICITY.

1928. Elastic Failure and Buckling of a Steel Column under Eccentric Loads. C. Sunatani and T. Yûki. *Tohoku Univ., Technol. Reports*, **12.** **2.** *pp*. 23–106, 1937. *In English.*—An elaborate investigation taking account of the eccentricity of the loading, which may be different at the two ends, considering in addition to the critical load, the position and amount of maximum bending moment and deflection under load. The effect of stresses above the limit of linear elasticity is also considered, making use of an idealised stress-strain diagram composed of straight line segments. W. G. B.

1929. Deflection of Unsupported Beams under Variable Loads. R. A. Fairthorne. *Phil. Mag.* 23. *pp*. 580–590, *April*, 1937.—While the deflections of a supported beam under loading which varies in amount or position have been studied in detail, the case of the unsupported beam has received little consideration. It does, however, represent an approximation to the case of a ship or an aeroplane, each of which is an elastic structure acted upon by variable loading. The deflection is worked out for a general load system, on the assumption that the angle of pitch, as well as the deflection, is small. The results are given as series of "normal functions." The strain energy is also calculated, and used to obtain an upper limit to the effect of a varying force. The defects of the present theory, from a practical point of view, are due to the neglect of internal damping, and to the implication that the wave velocity increases without limit with the frequency. Nor can the present theory take correctly into account the effects of a localised impulse, for the macroscopic effects cannot be determined without taking into account the local stress distribution in the region where it acts. W. G. B.

1930. Symmetrical Flexure of an Angle-Iron. B. R. Seth. *Phil. Mag.* **23.** *pp*. 745–757, *April*, 1937. *Supplement.*—The very general solution of Laplace's equation satisfying a given boundary condition, the boundary consisting of straight lines only, recently obtained by the author [see Abstract **4475 (1935)**] is applied to discuss the symmetrical flexure of an angle-iron of finite section. The treatment employs the method of conformal transformation. J. S. G. T.

1931. Dynamical Measurement of Young's Modulus for Imperfectly Elastic Metals, and Application to Nickel and Its Alloys. R. M. Davies and I. H. Thomas. *Phil. Mag.* 23. *pp*. 361–397, *March*, 1937.—The essential feature of the method is to extrapolate to zero amplitude the resonant pulsatance for a loaded bar of the material whose vibrations are electrically maintained. W. G. B.

1932. Frequency of Transverse Vibration of a Loaded Bar. Parts II and III. R. M. Davies. *Phil. Mag.* **23.** *pp.* **464–475,** *March, and pp.* **563–573,** *April,* **1937.**—Discusses various methods of approximation, and also the solution of the exact equation. In Part III the effect is calculated of the rotatory inertia of the bar, and it is found that the neglect of this gives rise to some uncertainty in the value of Young's modulus deduced from the experiments, but that it is unlikely to exceed 0·12 %. [See also Abstract 5400 (1936).] W. G. B.

1933. Effect of Temperature on Stretched Rubber Bands. M. L. Braun. *J. of Applied Physics,* **8.** *pp.* **138–141,** *Feb.,* **1937.**—The contraction of stretched rubber with rise in temperature is verified and also its positive elongation when unstretched or when but slightly stretched. The relation between rate of elongation and load is also discussed. J. K.

See also Abstracts 1920, 1940, 1952, 1954, 2194.

GRAVITATION.

1934. Measurement of Gravitational Force. R. Tomaschek. *Naturwiss.* **25.** *pp.* **177–185,** *March* **19, 1937.**—A non-technical account is given of the methods and results of measuring the force of gravity over the earth's surface. The variations in gravitational attraction found over the surface and the changes due to the sun and the moon are described. G. C. McV.

See also Abstracts 1953, 1987.

HYDRODYNAMICS AND AERODYNAMICS.

1935. New Stream-Function for the Motion of Gases with Vorticity. L. Crocco. *Zeits. f. angew. Math. u. Mechanik,* **17.** *pp.* **1–7,** *Feb.,* **1937.**—Because of the change of entropy at a shock wave, motion of an inviscid gas may not be irrotational if the local velocity of sound is exceeded anywhere in the field. In such cases a velocity potential does not exist, and the usual stream-function is unsuitable because of the appearance of the density, which cannot easily be eliminated since the adiabatic relation has ceased to hold. A new stream-function, defined in terms of the velocity components only, is introduced, which coincides with the usual stream-function for irrotational, but not for rotational, motion. In two-dimensions the definition is $u(1-w^2)^{1/(k-1)}. = \delta\psi/\delta y$, $v(1-w^2)^{1/(k-1)}. = -\delta\psi/\delta x$, where (with the limiting velocity for expansion into a vacuum as unit), w is the resultant velocity, (u, v) its components, k the ratio of the specific heats. The equation satisfied by ψ is discussed, and similar results given for flow symmetrical about an axis (in which case the right hand sides of the above equations must be multiplied by the distance from the axis in the definition of ψ, and u, v are components along and perpendicular to the axis of symmetry). S. G.

1936. Aerodynamic Characteristics of a Cylinder Having a Heated Boundary Layer. E. G. Richardson. *Phil. Mag.* **23.** *pp.* **681–695,** *April,* **1937.** *Supplement.*—Recent developments in the theory of the boundary layer in fluid motion indicate that it is the local Reynolds number peculiar to a layer near the wall of an obstacle in a stream rather than that proper to the complete obstacle which determines the resistance shown by the obstacle to the motion of the fluid. This suggests that a cylinder having an "ultra-viscous" boundary layer may, under certain conditions, show a less resistance than that of a normal cylinder. Experiments to test this point are described, in which the " lubrication " of the boundary layer is attained through heating the cylinder, and hence the air in its vicinity, and the gain discussed in the light of the temperature gradient in the boundary layer. The paper concludes with a note on the "dust-free space," examined in conjunction with these results. AUTHOR.

1937. Bifurcation of a Liquid Stream by a Circular Obstacle. C. Jacob. *Accad. Lincei, Atti*, 24. *pp.* 439–446, *Dec.* 6, 1936.—The paper is mathematical. W. A. R.

1938. Flow Around a Cruciform Obstacle. L. Sona. *Accad. Lincei, Atti*, 24. *pp.* 447–453, *Dec.* 6, 1936.—The paper determines the non-rotational motion of a plane liquid layer generated by an obstacle in the form of a cross in a current of translation. W. A. R.

1939. Periodic Source in Water with a Free Surface. H. Holstein. *Zeits. f. angew. Math. u. Mechanik*, 17. *pp.* 38–47, *Feb.*, 1937.—A rectilinear source of periodic oscillations in placed below the surface of an infinite extent of water of infinite depth. The resulting motion of the water is discussed as a two-dimensional hydrodynamical problem on the assumption that (1) the disturbance of the water is attributable to stationary oscillations, and (2) that the amplitudes of the resulting surface waves are small compared with their wave-lengths. In particular, the form of the free surface is derived. J. S. G. T.

1940. Self-Maintained Oscillations of the Extremities of Elastic Tubes Discharging a Continuous Current of Fluid, and the Oscillations of Free Reeds Fitted Upstream. F. J. Bourrières. *Comptes Rendus*, 204. *pp.* 654–656, *March* 1, 1937.—In continuation of previous work relating to the self-maintained plane oscillations of the free ends of elastic tubes discharging a continuous stream of air or water [see Abstract 2227 (1932)] the author shows mathematically that the oscillations of a free reed mounted upstream parallel to the flow of fluid obeys qualitatively the same laws as the free ends of the tube. The theoretical results are correct to within 10 % for a stream of air, and to within 25 % for water. Stroboscopic views of the oscillations generated in a stream of air are given. **Erratum,** *ibid. p.* 1048, *March* 31, 1937. J. S. G. T.

1941. Two-Dimensional Potential Theory. Part II. Hydrodynamical Problems on the Motion of Cylinders. Rosa M. Morris. *Phil. Mag.* 23. *pp.* 757–762, *April*, 1937. *Supplement.*—Wilton [see Abstract 159 (1916)] has discussed the general case of the motion of a cylinder of any form, whose cross-section is defined unicursally, in a fluid at rest at infinity; the results are given in terms of the real velocity and stream functions. It is now shown how the general result can be simplified by the consistent use of the complex potential throughout the discussion. Solutions obtained by Wrinch for a cylinder of a specified cross-section [see Abstract 763 (1925)], and for a cylinder of thin aerofoil cross-section are derived as special cases. [See also Abstract 1361 (1937)]. J. S. G. T.

1942. Instability in the Boundary Layer in a Channel of Small Divergence. G. Rosenbrook. *Zeits. f. angew. Math. u. Mechanik*, 17. *pp.* 8–24, *Feb.*, 1937.—The velocity distribution in a channel of small divergence is obtained experimentally by a photographic method. The graph of the velocity has an inflexion, and is of the kind considered theoretically, and shown to be unstable for infinite Reynolds numbers, by Tollmien [see Abstract 4845 (1935)]. The measured velocity distribution is approximated by a polynomial, and Tollmien's method is applied to work out the details of a small harmonic disturbance of increasing amplitude. A critical Reynolds number is not found, an attempt to apply a variation of Osborne Reynolds' method ending in failure. S. G.

1943. Plane Jet. W. G. Bickley. *Phil. Mag.* 23. *pp.* 727–731, *April,* 1937. *Supplement.*—The spread of a jet issuing from a long narrow straight slit is investigated by the use of Prandtl's "boundary layer" equations, which in this case admits of a solution in closed form. A drawing of the stream-lines and of the velocity profiles across the jet is given. W. G. B.

1944. Radial and Spiral Flow of a Compressible Fluid. A. M. Binnie and S. G. Hooker. *Phil. Mag.* 23. *pp.* 597–606, *April,* 1937.—In the radial or spiral flow of an inviscid compressible fluid two velocity fields are possible, one in which the fluid velocity at infinite radius is zero and the other in which the velocity is everywhere greater than the local velocity of sound, reaching at infinity the maximum possible to a compressible fluid. The former we term convergent flow and the latter expanding flow. Our numerical work refers to air. In radial flow the velocity distributions for both cases have been computed directly, and it is shown numerically that for convergent flow the method of successive approximations (suggested by G. I. Taylor) converges to the correct result. Taylor's process can never be made to yield the solution for expanding flow, and we have therefore suggested an alternative sequence which will converge under these conditions. It has been supposed that Taylor's process will diverge whenever the fluid velocity exceeds the local speed of sound at any point in the velocity field. This supposition is found to be incorrect in the case of convergent spiral flow. Here there exist regions in which the fluids velocity considerably exceeds the local velocity of sound : yet Taylor's process is shown to yield the correct result. AUTHORS.

1945. Flow of an Incompressible Fluid. A. M. Binnie and S. G. Hooker. *Roy. Soc., Proc.* 159*A*. *pp.* 592–608, *April* 15, 1937.—This paper is concerned with the flow of water under gravity along a vertical walled, horizontal channel of varying cross-section ; and with the analogy which exists between this flow and the two-dimensional flow of a compressible fluid under the same boundary conditions. The approximate theory of the water flow is precisely similar to that given by Osborne Reynolds for the flow of a compressible and inviscid gas through a nozzle. In order to test this theory, a channel of rectangular cross-section was constructed, a throat being formed in it by two symmetrically placed circular arcs. The discharge and the variation in depth of water along the axis of the channel under free flow were measured, and the experimental results showed a substantial difference from the predictions of the approximate theory. It was also found that vertical velocity gradients can lead to considerable errors if the static pressure on the bottom of the channel be taken as equal to the height of the water column above. The discharge coefficient based upon the throat depth maintained an almost constant value of 0·89, independent of the total head in the supply tank. On the other hand, discharge coefficients based upon throat pressure or upon total supply head showed considerable variation over the experimental range. For a thin sheet of water a hydraulic analogy holds, the flow through the constriction being similar to that of a compressible gas obeying the pseudo-adiabatic relation pv^2 = constant. Using this analogy, the series expansion method employed by Taylor for the calculation of the flow of a compressible gas in the neighbourhood of curved surfaces can be used; and the experiments show that as the sheet becomes thinner the depth at the throat tends to be exactly that calculated by Taylor's method. AUTHORS.

See also Abstracts 1952, 2163.

KINETIC THEORY OF MATTER.

See Abstracts 1889, 2158.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

***1946. Torsion Balances. W. W. Loebe.** *A.T.M. No.* 68. *T25–T26, Feb.,* **1937.**—A short description of the principles of construction and the nominal performances of some true torsion balances and spiral spring balances which are on the market. Those dealt with are for maximum loads of 0·3 mg. to 10 gm. and are sensitive to between 1/200 and 1/1000 of these loads. P. H. B.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

1947. Pseudo-Operational Method. T. Itoo. *Tohoku Math. J.* **42.** *pp.* **230–247,** *Dec.,* **1936.**—Heaviside's operational method though of great practical value and much used by electrical engineers lacks a rigorous mathematical basis. The operator has a dual function, sometimes it is operator sometimes a number, and this duality cannot be removed. The method cannot be proved; it can only be justified. The author introduces a new method consisting essentially of three parts: (1) construction of the subsidiary equation, (2) deduction of the generating function, (3) the interpretation. The new method is based upon Laplace's transformation, by means of which a differential equation is changed into an algebraic one. The weakness of the new method is that the operator ceases to have the free behaviour possessed by Heaviside's. Its superiority over Heaviside's method lies in the strictness and wider extension of the deduction. J. J. S.

1948. Relation Between "Spectra" and Poles of Operator. T. Sakurai. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 108–127, *Feb.,* 1937. *In English.*—A strict proof is given of the method of solving partial differential equations by the generalised Heaviside's operator. (The "spectrum" of this paper means merely the characteristic number (*Eigenwert*) of the normal function). A. H.

1949. Integral Expressions for Bessel Functions. N. W. McLachlan and A. L. Meyers. *Phil. Mag.* **23.** *pp.* **762–774,** *April,* **1937.** *Supplement.*

1950. Laguerre Polynomials. W. T. Howell. *Phil. Mag.* **23.** *pp.* 807–811, *April,* 1937. Supplement.

1951. Mathematical and Physical Meaning of Probability. T. E. Sterne. *Science Progress, No.* 122. *pp.* 250–257, *Oct.,* 1936.—The author examines the question of whether a description of probability can be given in scientific terms, and of what is meant by probability in the mathematical sense and also in a form applicable to physical problems. The simple mathematical notions are developed and extended to classical physics where it is shown that fundamental dynamical difficulties lie in the way of establishing perfectly random selections. The way of escape from the difficulty of defining the probability of a physically selected event lies through phase space, via the dynamical equations of motion of the system considered. In quantum mechanics, following Dirac's treatment of the problem, it is shown that the anomaly arises that one is unable to trace the probability expressions back to the mathematical definition by any appeal to strictly deterministic dynamical laws, yet the expressions obey all the usual laws of probability. N. M. B.

***1952. Conformal Transformation with the Aid of an Electrical Tank. K. N. E. Bradfield, S. G. Hooker, and R. V. Southwell.** *Roy. Soc., Proc.* 159*A*. *pp*. 315–346, *April* 1, 1937.—Conjugate functions and conformal transformation play a considerable part in the theory of elasticity and in hydrodynamics, and the analogy with plane current sheets has been used in order to obtain experimentally the solution of problems where the analytical solution is difficult or impossible. The boundary conditions which can easily be satisfied in the electrical tank, however, are that one of the conjugate functions should be constant along each of the two (electrode) boundaries, and this has limited the applications of the tank. In the present paper, a method of dealing with more general boundary conditions by a combination of experiment and computation is developed. The tank is used to obtain the conformal representation of the space between two closed curves (the electrodes) and that between two concentric circles. The solution of the problem for the latter region is obtained by Fourier analysis, and the results are transformed back to the original region. As a test of the method the torsion problem for an equilateral triangular section is solved both analytically and experimentally, and the results show that adequate accuracy can be obtained by the new method. The paper contains a full description of both the experimental arrangements and of the auxiliary numerical work. W. G. B.

See also Abstracts 1924, 1932, 1941, 1968, 2136, 2196.

MECHANICS, CLASSICAL.

1953. More General Form of Kepler's Third Law. L. Laboccetta. *Accad. Lincei, Atti*, 24. *pp*. 358–363, *Nov*. 15, 1936.—The form taken by Kepler's third law when the " planet " consists of an aggregate of p atoms and q electric charges and the " sun " carries an electric charge is examined. Assigning integral values to p and q a system of " quantised " orbits is obtained. A formal correspondence between this generalised form of Kepler's third law and Planck's relation $E = nh\nu$ is noted.

W. S. S.

1954. Motion of an Extensible Membrane in a Given Curved Surface. C. E. Weatherburn. *Phil. Mag*. 23. *pp*. 573–580, *April*, 1937.—The equations of equilibrium and of motion of a membrane constrained to move in a given surface are obtained in vector form and some general theorems are stated. W. G. B.

***1955. Simple Method of Measuring Rotational Speeds. L. B. Snoddy and J. W. Beams.** *Science*, 85. *pp*. 273–274, *March* 12, 1937.—The measurement of rotational speeds over a wide range has become necessary owing to the development of the ultracentrifuge, for which the working speeds are usually between 500 and 3000 r.p.s. A direct-reading apparatus is described in which a small magnet fixed to the high-speed rotor or driving turbine induces an alternating current in a coil. This coil is connected across an a.c. bridge consisting of 4 fixed non-inductive resistances, but in series with one of these is included a variable capacity and a variable inductance which enable the bridge to be balanced at the induced frequency. A special advantage is that the balance of the bridge may be used indirectly to control the rotational speed. H. B.

See also Abstracts 1929, 1951, 1962, 1977.

MECHANICS, QUANTUM.

1956. Dirac's Theory of the Electron. Part I. M. Markov. *Phys. Zeits. d. Sowjetunion*, 10. 6. *pp.* 773–808, 1936. *In German.*—A number of the quantities associated with Dirac's equation can be split into two parts, in the same way in which the angular momentum can be split into the "orbital" and the "spin" part. The significance of this division is discussed. R. P.

1957. Heisenberg's Uncertainty Relations and Logic. Paulette Février. *Comptes Rendus*, 204. *pp.* 481–483, *Feb.* 15, 1937.—It is pointed out that the principles of quantum theory, in view of the existence of the uncertainty relations, can be based on a system of logic in which a proposition may be true, or false, or false contingently on the truth of some other proposition. G. C. McV.

1958. Waves and Corpuscles in Quantum Physics. A. Landé. *Science*, 85. *pp.* 210–213, *Feb.* 26, 1937.—The conflict between wave and corpuscular theory is discussed, and it is pointed out that many apparent contradictions are due to uncritical over-interpretations of observed facts. Quantum theory is based on the essential complementarity of waves and corpuscles, and each should be confined to its own sphere in interpreting observations and not fused into inconsistent ideas. This is illustrated by reference to the interpretation of the Schrödinger wave function, of energy levels, and of linear harmonic oscillators illuminated by light waves or by photons. Quantum theory, however, gives dependent mathematical relationships, and the corpuscular interpretation of ψ works in describing macroscopic as opposed to microscopic observations; intermediately there is a compromise between the two. N. M. B.

1959. Relativistic Quantum Mechanics. B. Kwal. *J. de Physique et le Radium*, 8. *pp.* 81–87, *March*, 1937.—An attempt to develop a mechanics consistent with the theory of relativity is made on the hypothesis that all physical magnitudes possess four components in space time which are functions of a quadrivectorial parameter. The mathematical development requires the use of quaternions. Analysis by means of quaternions is fully discussed. It is shown how the equation of Dirac is obtained simply and directly from Lorentz, most general transformation, applied to the quadrivectorial quantity energy of motion P, by replacing P in this transformation by an expression in agreement with the quantum postulate. In arriving at the equations of a relativistic quantum mechanics it is admitted that the elements of the matrix are quaternion exponential functions of the point of space time. The uncertainty relations found are discovered to have the correct relativistic variance; while also the quaternion theory leads to a quadrivectorial statement of Ritz principle in perfect agreement with the theory of relativity. G. O. B.

1960. Hartree and Hartree-Fock Methods. N. H. Frank. *Phys. Rev.* 51. *pp.* 577–583, *April* 1, 1937.—Certain limitations on the Hartree and Fock methods of handling many-body problems in quantum mechancis are discussed with the help of simple examples. One may treat the interaction in such problems as composed of two parts: first, a part which is correctly accounted for by the above methods, and secondly, a part which is entirely omitted in these approximations. If the latter type of interaction is not negligible one may be led to two types of solution of a problem; first, a complete set of orthogonal Hartree wave functions, and secondly, additional wave functions of entirely different nature from the Hartree functions. These two types of solution are not independent, however, and it is shown how to establish connections between them with the help of perturbation methods. The importance of these limitations in connection with the theory of nuclear structure is pointed out. AUTHOR.

1961. H-Theorem in Quantum Mechanics. T. Sakai. *Phys. Math. Soc. Japan, Proc.* **19.** *pp.* 172–189, *Feb.*, 1937. *In English.*—To formulate the H-theorem in quantum mechanics a special system of axes in Hilbert space must be selected, with reference to which the statistical assembly is specified. The curve of the H-theorem always descends in the course of time due to the fact that this sytem of axes does not coincide with the system of the characteristic functions of energy, or, to the fact of diffusion of the wave function. Developing on this basis, a close connection is found between the theories of Pauli and of Neumann on the H-theorem; the process of averaging over the phase constants in Pauli's theory exactly corresponds to the process of measurement in quantum mechanics and such process is also implied in Neumann's theory. Adopting the standpoint of Gibbs' statistical mechanics, as the special axes of reference in Hilbert space the system of characteristic functions of Neumann's macroscopic quantity R is taken, but instead of the H-function of the state itself, a more general function H_t is considered belonging to any statistical assembly specified by R and possessing a closer similarity with Pauli's H-function. The quantum mechanical curve of the H-theorem produced by successive measurements of R at arbitrary intervals of time is defined, and finally the H-function G is obtained belonging to the micro-canonical assembly produced from the assembly under consideration by the macroscopic measurement of energy E. Neumann's proof of the H-theorem is extended, and it is shown that the curve of the H-theorem always descends and approaches the micro-canonical H-function G finally. Thus the two standpoints of Pauli and Neumann are unified. N. M. B.

1962. Quantum Mechanics and the Final Jacobi Multiplier. R. Dugas. *Comptes Rendus,* **204.** *pp.* 749–751, *March* 8, 1937.—A quantum. mechanical expression is formulated, corresponding to the Hamiltonian equations of classical mechanics, in respect of which an analogous interpretation of probability in the two systems can be traced. N. M. B.

See also Abstracts 1871, 1951, 1963, 1965, 1976, 2019, 2124, 2127, 2149, 2215.

RELATIVITY AND ETHER.

1963. Generalisation of the Lorentz Transformation for a System of Particles. J. L. Destouches. *Comptes Rendus,* **204.** *pp.* 849–852, *March* 15, 1937.—The transformation previously reported [see Abstract 89 (1937)], confined to infinitesimals, is now extended by the formulation of expressions for finite transformations, and certain of their properties are examined.

N. M. B.

1964. Geodesic Postulate in General Relativity. V. V. Narlikar and J. Singh. *Phil. Mag.* **23.** *pp.* 628–632, *April,* 1937.—It is argued that the geodesic postulate is not implicit in the relativity equations. A certain indeterminacy about the motion of the particle in Schwarzschild's solution is indicated. If the field equations are also to give the motion as suggested by Einstein the geodesic postulate must be abandoned, in which case the difficulty still remains whether a singularity in a solution does represent a mass-particle or not. If the geodesic postulate is to be retained, and if at the same time Einstein's suggestion is accepted, then certain tracks must reduce to geodesics in the limit, provided the singularities represent masses. This may serve as a test whether a singularity represents a mass or not. AUTHORS.

1965. Relativistic Conception of the Principle of Causality. W. Scherrer. *Helv. Phys. Acta,* 10. 2. *pp.* 157–162, 1937. *In German.*—After referring to the difference in the conception of the nucleus and of the electron in the wave mechanics treatment of the H atom, the author suggests that the classical conception of physical causality appears, in the light of relativity theory, to be a totally unnatural idea. Difficulties associated with the conception of an atom are referred to, and it is suggested that the presence of a stationary atom at the origin of coordinates at time $t = 0$ is synonymous with the hypothesis that a sufficient length of the negative time axis is occupied by elements of action. The past is thus conditioned in a perfectly definite manner; the future is indefinite. The theory is illustrated by the deduction of the wave equation in a scalar, non-relativistic wave-mechanical theory. J. S. G. T.

See also Abstracts 1959, 1968, 1977.

SOLUTION.

See Abstracts 1923, 2135.

SURFACE TENSION AND COHESION.

1966. Surface Tension of Intensively Dried α-Sulphur Trioxide. A. N. Campbell and N. O. Smith. *Faraday Soc., Trans.* 33. *pp.* 545–551, *April,* 1937.—SO_3 was intensively dried for several months by passing its vapour through P_2O_5. The density and surface tension of successive fractions were determined. No change in the mean density was observed, but the density at 20° of successive fractions varied considerably while the densities at 50° were practically invariable. Similar behaviour was observed with the surface tension. The surface tension of the whole was lowered distinctly below the figures of predecessors. This behaviour has been interpreted in the light of Smits' theory. The melting-point ranges of solidified α-SO_3 have been determined and great heterogeneity demonstrated. AUTHORS.

1967. Optical Contact. (Lord) Rayleigh. *Roy. Inst., Proc.* 29. 3. *pp.* 432–443, 1937.—Experiments which indicate imperfect contact on reflection at the interface of two glass surfaces and on the tension required to separate them are described. The effects of abrasion or polishing on the surface of silica glass are explained. A method for determining the optical character and thickness of the skin for silica is described which involves a determination of the shift of interference fringes when part of the altered surface has been removed. Finally, a method to determine the work done in separating two contacted surfaces is described. R. S. R.

See also Abstracts 1891, 1969.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

1968. Measurement of Time. H. Dingle. *Nature,* 139. *pp.* 355–357, *Feb.* 27, 1937.—It is pointed out that time is measurable only indirectly, a sequence of events being chosen between consecutive members of which there is an interval of some measurable physical magnitude and time intervals being defined as proportional to the corresponding intervals of this magnitude. In physics intervals of space are commonly used for measuring time. The author points out that other physical magnitudes, entropy for instance, could be used to measure time. A change of method of measurement entails alterations in all propositions connected with the intervals between events in time. Thus entropy tends to a maximum if time is measured spatially but not if time is measured by entropy itself. G. C. McV.

See also Abstract 1955.

VISCOSITY, FRICTION AND LUBRICATION.

***1969. Suspended-Level Measurement of Viscosity and Other Properties of Liquids. L. Ubbelohde.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 85–90, *Feb.* 15, 1937.—The lower end of the capillary in a viscometer of the Ostwald or the Ubbelohde type is made to open into a wide-bore tube connected to the atmosphere; this latter tube becomes filled with air and the liquid runs down the walls of the tube during efflux. This is described as the suspended level; if it be plane it eliminates the lower surface tension correction besides providing a fixed lower level for computing the pressure head, while if it be of a prefixed radius (concave downwards) it may be made to eliminate the surface tension correction entirely, by balancing the effects of the upper and lower surfaces. The suspended level may be applied to the constant-head device employed with the Ubbelohde viscometer, leaving only the kinetic energy correction to be applied. Static and dynamic values of surface tension may be determined by using the capillary of a viscometer fitted with the suspended level device. L. V. C.

1970. Viscosity of Aqueous Solutions as a Function of Concentration. Part V. G. Jones and S. M. Christian. *Am. Chem. Soc., J.* 59. *pp.* 484–486, *March*, 1937.—The absolute density and relative viscosity of many aqueous solutions of NaCl are determined at 0 and 25°, covering the range of concentration from 0·002 to 2*N*. The density of these solutions as a function of the concentration can be expressed by the Root equation, and the viscosity by the Jones and Dole equation. [For Part IV see Abstract 547 (1937).] AUTHORS.

See also Abstract 1890.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1971. Photoelectric Guidance of Astronomical Telescopes. A. E. Whitford and G. E. Kron.** *Rev. Sci. Instruments*, 8. *pp.* 78–82, *March*, 1937.—The device described is an automatic telescope guider exercising control in one co-ordinate only. A 90° roof-prism aluminised on its upper surfaces is set in the focal plane of the telescope and divides the light of a guiding star into two beams, which are fed alternately into a photo-cell. If the star image is not exactly centred on the knife-edge, the resulting flicker produces an alternating e.m.f. which is amplified and used to drive a correction motor until the flicker stops. The correcting impulse being proportional to the need for it, over-correction is eliminated. No mechanical relays are used, control being exercised entirely by electron tubes. In order to obtain a high signal-to-noise ratio, the photosensitive element chosen is actually a Zworykin electron multiplier. Full details of the amplifier are given. The guider works on $1\cdot4 \times 10^{-9}$ lumen, and it can therefore be operated by a star of magnitude 8·6 in a 60-in. telescope. Duplicating the device would provide control in both coordinates. A. Hu.

***1972. Large Telescopes Including the 200-Inch Reflector. H. S. Jones.** *Roy. Inst., Proc.* 29. 3. *pp.* 420–431, 1937.—The advantages possessed by reflecting over refracting telescopes and of an Al film over a Ag film are described. The objections to the use of glass for the mirror led to the use of a special type of pyrex glass for the 200-in. telescope. The construction of this glass mirror, the design of the telescope mounting for it, and the focal lengths to be used, are explained. The cost will be £2,000,000. It will be used to study the remote island universes and by finding whether the reddening of the radiations is a velocity effect it will provide an observational test for the theory of an expanding universe.
R. S. R.

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COMETS AND METEORS.

1973. Absolute Brightness of Comet 1936a (Peltier). N. Richter. *Zeits. f. Astrophysik*, 13. 3. *pp.* 186–195, 1937.—Observational material, both visual and photographic, concerning the brightness of the comet is collected and examined. The mean light-curve obtained by plotting the comet's apparent magnitude against time shows a steady rise in brightness from 10 mag. in mid-May through perihelion in early July to 3·5 mag. at the beginning of August. Most of the rise is due to the comet's approach towards the earth, but the absolute brightness, in which the varying distance from the earth and from the sun has been allowed for, also rises slightly. This confirms the spectroscopic evidence (bright-line emission) that not all of the light is reflected sunlight. The application of a correction for variable phase is fully discussed, and a term inversely proportional to the 4th power of the solar distance is introduced to allow for the comet's self-luminosity. The remaining variation with time is attributed to a real colour-index alteration whose origin is discussed. The contribution made to the total light by the cometary nucleus is calculated as a function of time. A. Hu.

1974. Spectrum of CO in the Head of the Peltier Comet. J. Dufay, Marie Bloch and J. Ellsworth. *Comptes Rendus*, **204.** *pp.* 663–665, *March* 1, 1937.—Over 250 wavelengths have been measured in the spectrum of the head of the Peltier comet between 15th and 28th July, 1936, but no image could be obtained from the tail. The most intense images are given by Swan spectra, and especially by the violet and red CN spectra. CO bands usually considered to be characteristic of the tail, have been observed in the head, being confirmed by characteristic doublets. Wave-lengths are about 0·5 Å higher than those observed by Baldet for CO excited by electric spark, due perhaps to the smaller dispersion in the former. In general the tail spectra of comets correspond closely, in respect to wave-lengths, with dispersed spectra produced in the laboratory. Wurm [see Abstract 3575 (1934)] explains the absence of C^2 and CN bands from the tails as due to the short life of these molecules when exposed to solar radiation, bnt this will not explain the absence of CO in the head, It is suggested that the CO spectrum of the tail is too feeble to be photographed under the same conditions as that of the head, in this case.

D. R. H.

1975. Nitrogen in Cometary Spectra. J. Dufay. *Comptes Rendus*, **204.** *pp.* 744–746, *March* 8, 1937.—Up to now only the most intense bands of the ionised molecule are found in comets' tails, in company with CO + bands [see Abstract 1907 (1932)]. The author finds on plates of Comet Peltier: (1) N_2^+ in the head spectrum with CO +; (2) N_2 (first and second positive systems); (3) N_2 (Vegard-Kaplan bands). Of these a table is given for the night sky, for Comet Peltier, and for a cometary nucleus; (4) NO (for which there are several precise coincidences); (5) resonance and fluorescence in the bright bands [see Abstract 1476 (1929) and 2368 (1934).]

A. S. D. M.

COSMOGONY.

1976. Quantum Equations in Cosmological Spaces. A. H. Taub. *Phys. Rev.* 51. *pp.* 512–525, *March* 15, 1937.—The Dirac equations for a free electron in a cosmological space are solved by means of separation of variables. It is shown that the wave functions depend on the angles θ and ϕ in the same manner as those of a free electron in flat space time. The radial functions are obtained and it is shown that they go over into the usual ones in the limit. The explicit form of the time dependence of the wave functions cannot be obtained until an arbitrary function $R(t)$ is specified. Three different cases are discussed. The energy of the free electron is then determined for each of these. Finally the connection between the equation used here and that proposed by Dirac for the DeSitter space is discussed. It is shown that they are similar and that the imaginary part of the complex mass that he was forced to introduce has a geometrical origin.

AUTHOR.

1977. Kinematics, Dynamics and the Scale of Time. Part III. E. A. Milne. *Roy. Soc., Proc.* 159*A*. *pp.* 526–547, *April* 15, 1937.—In continuation of previous work [see Abstract 1560 (1937)] the equation of motion of a particle in the t-dynamics is shown to have two analytically distinct energy integrals. These are used to isolate a definition of a conservative field of force in the t-dynamics which is compatible with the usual conservation law. The equations of motion are then transformed from t-measures in flat space to τ-measures in hyperbolic space. The result is that the " cosmical terms " in the t-equations disappear, leaving equations of pseudo-Lagrangian type. Thus the world-terms in the *t*-forms give rise to purely inertia terms in the *τ*-forms. The local forms of the equations are obtained and compared with Einstein's "special relativity" mechanics. The new forms differ from Einstein's in being valid in the presence of the matter of the universe. Transformations of force and of linear and angular momentum are carried out from *t*-measures to *τ*-measures. AUTHOR.

See also Abstract 2083.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1978. Dynamics of a Stellar System. G. L. Clark. *Roy. Astron. Soc., M. N.* 97. *pp.* 182–202, *Jan.*, 1937.—The determination of the general form of the spatio-velocity distribution of a stellar system moving under given forces and in a steady state is discussed. The equivalence of the methods of Jeans and of Eddington is worked out. If the distribution function is of the form $f\,(a^2L^2 + b^2M^2 + c^2N^2)$, where L, M, N are the velocity-components along the principal directions of an orthogonal co-ordinate system, then Jeans' method gives the most general form of *f*. But if the function is of form $f(a^2L^2 + b^2M^2 + c^2N^2 + 2f\,MN + 2gNL + 2hLM)$, then Eddington's method must be used to obtain the general solution. G. C. McV.

1979. Variations of Angular Velocity in a Fluid Asteroid. P. Dive. *Comptes Rendus*, 204. *pp.* 661–663, *March* 1, 1937.

NEBULÆ.

1980. Illumination of Reflection Nebulae. L. G. Henyey. *Astrophys. J.* 85. *pp.* 107–138, *March*, 1937.—The general theory of illumination by stars, of reflection nebulae is discussed. The author finds for starlight scattering by large particles an equation corresponding to that of small particles in the theory of absorption and emission. He translates it into graphical form, showing the intensity gradient outwards from the centre, according as the illuminating star is within or in front of the nebula. Plates are given of IC 1284 and 1287, of BD + 8°·933 and of the Scorpius and Ophiuchus regions. IC 1287 has its nebula to one side, the maximum intensity lying SW of the star, which is about 100,000 A.U. in front of it. So too, IC 1284 has its nebula inclined. In the Scorpius-Ophiuchus group there is no selective scattering as the particles are fairly large. *ρ* Ophiuchi is about a parsec in front of the material of its nebula, and CD−24·12684 seems deeply imbedded in the material it illuminates. As regards 22 Scorpii, the interpretation of the various facts seem contradictory, one set indicating that it is behind the nebula, the other that is in front of it. A. S. D. M,

PLANETS.

See Abstracts 1979, 2015.

STARS.

1981. Spectroscopic Absolute Magnitudes of 370 Southern Stars. Dorrit Hoffleit. *Nat. Acad. Sci., Proc.* 23. *pp.* 111–114, *Feb.*, 1937.—The principal results of a survey of spectroscopic absolute magnitudes for stars between dec. − 20° and the S. pole are summarised. The spectra of 370 stars of type later than A5 and brighter than the 5th apparent visual magnitude were obtained with a single objective prism on a 13-in. telescope. The revised Draper classification used is compared with the Mt. Wilson system. Absolute magnitudes are derived from the ratios in intensity of various pairs of lines, the number of pairs available in any one spectral class varying from 4 to 10. Correlation of the intensity ratios with absolute magnitudes is based on : (*a*) spectroscopic absolute magnitudes determined at Mt. Wilson for 140 stars in common with this investigation, (*b*) trigonometrical parallaxes, and (*c*) proper motions. The average probable error of a mean absolute magnitude is 0·15 mag. The values obtained are compared with those of other observatories, and in particular with the Mt. Wilson results ; and with those obtained by other methods, especially by estimation from trigonometrical parallaxes. A. Hu.

1982. Derivation of the General Velocity-Ellipsoid from Proper Motions. J. Fleming. *Roy. Astron. Soc., M.N.* 97. *pp.* 173–182, *Jan.*, 1937.—On the assumption of a general ellipsoidal distribution of stellar velocities, it is shown how the constants involved and the position of the solar apex can be found from proper motion data alone. Applied to Smart's eight regions of the sky, the solar apex is found to have the coordinates R.A. 272°·4, Dec. + 43°·1. G. C. McV.

1983. Scattering of Light in a Stellar Atmosphere. L. S. Ornstein. *Roy. Astron. Soc., M.N.* 97. *pp.* 207–212, *Jan.*, 1937.—A slab of matter included between infinite parallel planes is treated as scattering a stream of photons incident upon one face. By considering the groups of photons scattered by 0, 1, 2, . . . *n* collisions, the author develops a series of simultaneous differential equations by which the total scattering may be calculated to the *n*th degree of approximation. The treatment is then extended to the case in which a point source of light at the centre of a star has its photons scattered by successive shells of matter around it. Refinements are introduced by allowing for preferential scattering in a given direction, and in particular for Rayleigh scattering ; and for the absorption of photons. The calculations involved are more tedious than those necessary in the approximate methods hitherto used, but have the advantage that the physical meaning of each step is clearly shown. The method is susceptible to treatment by the wave theory. A. Hu.

1984. Molecular Absorption in Interstellar Space. P. Swings. *Roy. Astron. Soc., M.N.* 97. *pp.* 212–216, *Jan.*, 1937.—The origin of the 4 recently-discovered interstellar yellow and red lines is discussed. Since no ultimate line of any atom of reasonable cosmic abundance coincides with any of the lines, the possibility of their molecular origin is examined. The lines at 6613·9 and 6283·9 Å are shown to coincide with the calculated origins of two CO_2 vibration-rotation bands to within 0·5 and 8·4 cm.$^{-1}$ respectively. If this identification is correct, the "Venus bands" at 7820 and 7883 Å should be strong in the spectra of sufficiently distant stars, and a search is projected. The relative narrowness of the bands might be explained by their low temperature of origin. A general discussion based on various reasonable assumptions indicates that their breadth should be about 2 Å., as observed. The absence of other CO_2 bands may be due to low transition probabilities, to blendings, or to observational difficulties. The general problem of the dissociative equilibrium of molecules in a radiation field is touched upon. A. Hu.

1985. Molecular Absorption in Late-Type Stellar Spectra. K. Wurm. *Zeits. f. Astrophysik,* 13. 3. *pp.* 179–185, 1937.—The origin of the

absorption bands found by Sanford and Shane in the blue region of late-N spectra is discussed. The positions of the band-head convergences in the $\Delta v = 0$ and $\Delta v = 1$ sequences of the C_2 Swan system are calculated and found to be within about 10 Å of the 2 strongest unidentified heads. It is therefore suggested that absorption from the higher vibrational levels of the lower $^3\Pi$ state concerned causes the development in the Swan system of " tail-bands " analogous to those well-known in CN. Such absorption would produce a spurious " head " and a structure degraded towards the red. A similar mechanism might also produce a quasi-continuous absorption by CN and C_2 in the blue-violet region of all R- and N-type spectra, and thus explain their deviation from the black-body type. With increasing molecular concentration in the later sub-types, this absorption will extend, as observed, towards longer wave-lengths. Absorption by oxides and hydrides may play a similar part in M- and S-type spectra.
A. Hu.

1986. Displacements of Detached Lines of Ca and Na in Stellar Spectra. P. W. Merrill and R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 564. *Astrophys. J.* 85. *pp.* 73–78, *March*, 1937.—In types B3 and earlier the measured displacements of detached D1 and D2 agree with those of H and K in the same stars, at least to a first approximation. A slight tendency for the values from the Na lines to be algebraically greater may be partly a regional effect. In types later than B3 comparison of Na- and Ca-line displacements brings out the existence of blending of interstellar with stellar Ca lines in types as late as A2. AUTHORS.

1987. Number of Incompressible Fluid Spheres of Given Radius. N. K. Chatterjee. *Roy. Astron. Soc., M.N.* 97. *pp.* 216–221, *Jan.*, 1937.—Extending Sen's work [see Abstract 2801 (1934)] on the sizes of spheres of constant proper density which are in gravitational equilibrium, and using higher pressures, the author determines the number of complete spheres possible for a given radius R. Integrating backwards from the free surface, he selects from the possible configurations only those in which w (the gravitational mass within a surface of radius r) vanishes simultaneously with r, *i.e.* from the possible spherical shells he chooses only perfect spheres. The results confirm Sen's calculations in that increasing central pressures give a series of " classical " spheres for which R increases from 0 to 0·996 (arbitrary units). Further increase of central pressure causes R to decrease to 0·727 (non-classical spheres of type A), and then to increase again to 0·786 (non-classical spheres of type B). Thus below $R = 0{\cdot}727$ only classical spheres exist; between $R = 0{\cdot}727$ and the maximum $R = 0{\cdot}996$ there are 2 regions within one of which there are 2, and within the other, 3 spheres. More than 3 never seem possible. A. Hu.

1988. Stellar Ionisation and Electric Fields. R. Wildt. *Roy. Astron. Soc., M.N.* 97. *pp.* 225–231, *Jan.*, 1937.—The author's study of the ionisation equilibrium of a stellar atmosphere under a temperature gradient is revised and completed [see Abstract 2077 (1936)]. G. C. McV.

1989. Nuclear Transformations in the Interior of Stars. C. F. v. Weizsäcker. *Phys. Zeits.* 38. *pp.* 176–191, *March* 15, 1937.—General astrophysical applications of our present knowledge of nuclear processes are discussed qualitatively. The hypothesis advanced is that at the temperatures existing in the interiors of stars, nuclear reactions produce complex nuclei from initially pure H, the energy liberated being the sole source of stellar radiation. These assumptions are shown to be broadly in accordance with the known facts of energy emission from stars and with the relative abundances of the elements in their atmospheres. The lighter nuclei arise from direct nuclear penetration by protons of high thermic velocity; the heavier by the agency of neutrons, which are perhaps the products of such penetrations or of interactions between deuterons. The processes which may produce the lighter elements, and the part played by β-disintegration therein, are fully discussed. Cyclic reactions, catalysed by α-particles, of the type $^4\text{He} \rightarrow {}^5\text{Li} \rightarrow {}^5\text{He} \rightarrow {}^4\text{He} + {}^2\text{D}$ probably occur; their exact course is shown to depend largely on the as yet unknown properties of the ^5_3Li nucleus. Model reactions showing the synthesis of heavy elements are also considered. The supply of neutrons will suffice for these processes if all such nuclei together are 100 times rarer than He. The bearing of these theoretical results on the observed abundance distribution amongst the elements, and in particular on the abundance of Fe and Pb, is discussed, and the effect on the reactions of convection currents near the star's centre considered. A possible connection between nuclear β-disintegration and Cepheid variability is remarked, and a short sketch given of the evolution of a normal star from an agglomeration of pure H. A. Hu.

1990. Stars with Cores of High Energy-Density. A. B. Severny. *Phys. Zeits. d. Sowjetunion*, 10. 6. *pp.* 843–846, 1936. *In English.*—In continuation of previous work [see Abstract 1545 (1936)], the author examines the equilibrium of a stellar configuration with a core possessing a density of energy so high that photons in statistical equilibrium create pairs of positrons and electrons by photoelectric interaction with nuclei. By calculating the mean momentum of these particles, the pressure P of such matter is shown to depend on the density ρ thus:— $P = \frac{1}{3}c^2\rho$, as for radiation. Thus the behaviour of photons and particles is similar in that they both give the same equation of state. The lower limit to the central density in such a star is calculated as a function of its mass. With ordinary stellar masses, this leads to the conclusion that the mean distance between the particles is smaller than their radii. It is therefore suggested that this state of matter can occur only in stars of large mass. A. Hu.

1991. Variable Stars in Globular Cluster N.G.C. 6402. Helen B. Sawyer. *Roy. Astron. Soc. Canada, J.* 31. *pp.* 57–59, *Feb.*, 1937.—The Ophiuchus cluster, N.G.C. 6402, has its brighter stars of the 15th magnitude, its cluster variables of the 16th, but ranks third in having 3 long periods of 18·75, 13·57, and 2·7952 days with magnitudes of 15·1, 15·6 and 15·8; these follow a period-luminosity law less steep in slope than Shapley's, but their magnitudes seem too faint by 0·75 magnitude; possibly two of them belong to the galaxy, not to the cluster. The cluster seems strongly obscured and the difference in absorption between this region and N.G.C. 6934 (of similar galactic latitude) is 1 magnitude. In 1929, the distance of the cluster was inferred as 19·7 kiloparsecs, from its brighter stars and integrated magnitudes and diameter, but obscuration should reduce this to 12 kiloparsecs. A. S. D. M.

1992. Photometric Investigation of the Galactic Clusters M 71 and Harv. 20. W. Krug. *Zeits. f. Astrophysik*, 13. 3. *pp.* 205–214, 1937.—Several photographs of the cloud in the Milky Way containing these 2 open clusters were taken on a reflecting and a refracting telescope, with the idea of obtaining the apparent magnitudes of their 70 component stars which are brighter than mag. 15. Standardisation of the plates is carried out by means of stepped exposures to the pole star, density comparisons being made both by direct visual estimation and by a photoelectric method. Photographic magnitudes are obtained from exposures on ordinary plates (effective $\lambda = 4250$ Å.), and photovisual magnitudes from panchromatic plates used in conjunction with a yellow filter (effective $\lambda = 5850$ Å). From these 2 magnitudes the colour index, and thence the spectral class, of each star is calculated, and plotted against its absolute magnitude, obtained from the apparent value and an estimate of the parallax of the cluster to which it belongs. The resulting Russell diagram is used to classify the clusters into Trumpler types. A. Hu.

1993. Spectrophotometric Measures of Nova Herculis for U.T. 1934 December 13·28. W. M. H. Greaves and E. Martin. *Observatory*, 60. *pp.* 65–70, *March*, 1937.—This paper comprises the results of analysis of a spectrograph of Nova Herculis, taken on the morning of its discovery, which on account of the comparatively poor conditions of exposure and lack of time to photograph a comparison star of about the same magnitude and altitude on the same plate, were not included in the main report of the observations of the Nova [see Abstract 2613 (1936)]. The U.T. of the exposure was 1934 Dec. 13·28. The measured values of energy per 1 Å of the continuous spectrum are tabulated; they are best fitted by a Planck curve at 10,800° corresponding to spectral type A5. The emission spectrum is definitely early B-type and the anomalously low colour-temperature cannot be accounted for by space-reddening. The ratio of energy emitted in Hβ to that emitted in Hα is calculated to be 0·87; this value should be contrasted with the lower value of 0·25 measured in the later stages of the Nova. The monochromatic magnitudes of the continuous spectrum at Hα and Hβ are given as 3·02 and 3·29 leading to 3·16 for the apparent magnitude at the time of exposure. The absolute half-intensity of Hα is found to be 3·12, a value which is tabulated with later values which when compared with apparent visual magnitudes leads to the conclusion that the brightness of the H "shell" of the Nova does not run parallel with visual brightness. J. E. K.

1994. Microphotometic Measurements in the Spectrum of Nova Herculis 1934. P. W. Merrill. *Mt. Wilson Observat., Contrib. No.* 563. *Astrophys. J.* 85. *pp.* 62–72, *March*, 1937.—The equivalent widths and residual intensities of the dark lines of component I are compared with corresponding data for α Cygni. The behaviour of the D lines of Na is exhibited by tracings and the results of intensity measurements are given. Data on D3 of He and the red Si II lines are included. The remarkable sequence of changes in the intensity and structure of the emission lines of Fe II and [O I] is illustrated. The relationships of these changes to the magnitude of the Nova and a hypothetical explanation of certain features are briefly discussed. One or two facts concerning the [N II] line λ 5755 and the unidentified line λ 6087 are given. This investigation is supplementary to that previously reported [see Abstract 130 (1936)]. The photometric data are incomplete, being presented as samples of what can be obtained from the numerous spectrograms. AUTHOR.

1995. Changes of Period in Long-Period Variable Stars. T. E. Sterne and L. Campbell. *Nat. Acad. Sci., Proc.* 23. *pp.* 115–117, *Feb.*, 1937.—The authors apply the statistical principles derived in a former paper [see Abstract 4471 (1934)] to the systematic examination for changes of period of 377 variable stars with periods usually in excess of 100 days. The stars include nearly all of the best-observed long-period variables. It is pointed out that many apparent changes of period can reasonably be ascribed entirely to statistical fluctuations among cycles

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having a natural dispersion. Variable periods are fully confirmed in SS Cygni, U Geminorum, and SS Aurigæ; partially confirmed in RX Andromedæ and Z Camelopardalis; and "suspected" in 20 of the remaining stars. The small percentage of stars to which changing periods can now be ascribed with assurance may arise in part from insufficiency of observational material; but even amongst stars which have been under observation for 100 years, very few are of variable periods. It is concluded that few of the previously reported changes of period among long-period variables are real. A. Hu.

See also Abstract 1978.

SUN.

1996. Darkening at the Sun's Limb in White Light. M. Minnaert. *Zeits. f. Astrophysik,* 13. 3. *pp.* 196–198, 1937.—It is pointed out that owing to such causes as selective extinction by the sun's atmosphere and selective absorption in the optical train necessary, no observer can make directly a satisfactory measurement of the darkening at the limb in white light: it must be obtained by integration from the values in monochromatic radiation, which are accurately known. This process is carried through and the results are embodied in a table showing the total radiation as a function of the distance r from the centre of the solar disc (radius R). For the purpose of comparison with theory, similar calculations are tabulated for the hypothetical case in which Fraunhofer lines are absent. Here the short wave-lengths are strengthened relative to the long, and the effect is enhanced. The equivalent wave-length λ (in Å) for which the observed darkening is equal to that calculated for total radiation varies across the disc thus: $\lambda = 5760 + 960r/R$. A. Hu.

1997. New Identifications of Solar Lines. Charlotte E. Moore. *Mt. Wilson Observat. Contrib.* No. 565. *Astrophys. J.* 85. *pp.* 79–87, *March,* 1937.—Of the 92 elements, 61 are present, 19 absent, 3 (Sn, Tu, Tb) are possibly present; the rest have insufficient solar or laboratory data. Li (λ 6707) and Rb (λ 7800) have been found in the disc as well as in sunspots; Os and Ir are now certain; Tm is found but only in the ionised state (like most of the rare earths); Ne is suspected in the chromosphere. A table is given of the 19 absent elements in order of excitation potential of the accessible lines. A. S. D. M.

1998. Hydrogen Emission in Chromosphere. D. H. Menzel and G. G. Cillié. *Astrophy. J.* 85. *pp.* 88–106, *March,* 1937.—In the 1932 eclipse chromosphere the Balmer lines are resolved as far as H_{31} and beyond this merge into a continuous spectrum from two causes. The authors find in the Balmer continuum, $\lambda\lambda$ 3640–3500, a temperature of 10,000° for chromospheric free electrons; from the intensity of the true Balmer continuum at λ 3647·4 they determine the population of states above H_{31}, and these are compared with corresponding states in thermodynamic equilibrium for the same number of electrons and protons at 10,000° C. From H_{20}–H_{31} the populations are equal; from H_{α}–H_{20} the chromosphere is deficient; for populations of large-quantum numbers, with free captures only, the chromosphere is double. In chromospheric H spectra there is probably both line excitation and electron capture. Chromosphere H emission may not be explained by the action of excess extreme u.v. radiation, far beyond the Lyman limit. A. S. D. M.

See also Abstract 2272.

GEOPHYSICS.

GEODESY.

1999. Calculation of Earth-Ellipsoids. V. Špaček. *Gerlands. Beitr. z. Geophys.* 49. 3. *pp.* 277–295, 1937.—By means of the sum of the squares of the deviations of the vertical upon a given ellipsoid of reference the sum of the squares of the deviations of a neighbouring ellipsoid can be calculated. This expression contains the coordinates of the centre of the second ellipse, the differences in the equatorial semi-axes, and the corrections of the supposed latitude and longitude of the origin of the network. W. A. R.

GEOPHYSICS, APPLIED.

2000. Properties of Geological Conductors (Spark Geology). V. Fritsch. *Beitr. z. angew. Geophys.* 6. 4. *pp.* 407–412, 1937. *English Abstract.*—The properties of geological conductors are represented by steric diagrams, the specific inductive capacity, the conductivity and the frequency being used as rectangular coordinates. Any geological conductor may thus be represented by a certain three-dimensional diagram. Geological conductors can be separated by radio prospecting methods only when their diagrams differ. Further diagrams illustrate the influence of structure, moisture, and salinity upon conductivity and field losses. [See also Abstract 4091 (1936).] AUTHOR.

2001. Localisation of a Spherical Body by the Eötvös Balance. G. Boaga. *Accad. Lincei, Atti,* 24. *pp.* 453–456, *Dec.* 6, 1936.—The problem of locating a spherical body by measurements with the Eötvös balance is generalised. It consists in determining the position from a series of measurements taken on lines north-south and east-west, whose vertical planes do *not* pass through the centre of the mass. W. A. R.

HYDROSPHERE, PHYSICS OF THE.

2002. Tidal Oscillations in a Rectangular Basin of Variable Depth. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 259–278, *Jan.*, 1937.—The oscillations in a rectangular basin with sides a and b were studied when the depth varies according to the law $h = h_0 (1 - x^2/a^2)(1 - y^2/b^2)$. The differential equations and boundary conditions are set out and integration performed in a double series of zonal harmonics. The normal modes are classified. Numerical results are obtained for the gravest mode and distribution of amplitude for oscillations symmetrical to the x-axis and anti-symmetrical to the y-axis for values of $a/b = 2$, 1 and $\frac{1}{2}$. Finally the accuracy of the results is tabulated. [See Abstract 2757 (1932).] R. S. R.

2003. Extension of the Ekman Theory of Steady Drift Currents. H. Ertel. *Gerlands Beitr. z. Geophys.* 49. 4. *pp.* 368–372, 1937.—The assumption that different coefficients of turbulence for the two horizontal components are associated with the turbulent impulse transfer, has made it possible to obtain an extension of the Ekman theory of drift currents. This theory of two coefficients leads to an angle of 45° between the tangential pressure of the wind and the surface drift and also yields the velocity distribution as a deformed Ekman spiral. R. S. R.

2004. Water Supply in the U.S.A. O. E. Meinzer. *Washington Acad. Sci., J.* 27. *pp.* 85–101, *March* 15, 1937.—A general account of the hydrological cycle is given. There follows also an account of the storage of water in rock formations, in the soil, the replenishment of underground reservoirs, and the relation of water to life. W. A. R.

LAND, PHYSICS OF THE.

2005. Viscous Behaviour in Crystalline Rocks Under Dynamo-Metamorphic Conditions. N. A. Haskell. *Gerlands Beitr. z. Geophys.* 49. 4. *pp.* 387–392, 1937. *In English.*—In the absence of definite experimental data, a certain linear relationship is assumed to hold between the rate of recrystallisation and the stress in a polycrystalline body undergoing recrystallisation under stress in the presence of a liquid phase. It is shown that this leads to a relationship between stress and strain of the same form as the Maxwell law of elasticoviscosity. This suggests that the theory of viscous fluid motion may be applicable to the deformation of deep-seated rocks during dynamic metamorphism in an orogenic zone of the earth's crust. AUTHOR.

See also Abstract 2018.

METEOROLOGY.

2006. Ozone Concentration at 9620 m. Determined by a Fluorometric Method. M. Konstantinova-Schlesinger. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 4. *pp.* 187–188, 1937. *In French.*—The method is a direct method and is very sensitive. The value of the O_3 concentration from samples of air obtained at the stated height is given and compared with that at 10 km. obtained by optical means. These are found to be in close agreement. It is hoped to test samples of air obtained at greater heights for O_3 concentration so that the distribution in altitude may be verified by direct observation. A. E. M. G.

2007. Chemical Exploration of the Stratosphere. F. A. Paneth. *Roy. Inst., Proc.* 29. 3. *pp.* 350–366, 1937. *Nature,* 139. *pp.* 180–182, *Jan.* 30, and *pp.* 220–223, *Feb.* 6, 1937.—Having referred to the discovery of the stratosphere the author proceeds to show how the chemist may be able to settle the question regarding any motion of air masses within the stratosphere. The distribution of gases of different densities in a long vertical column can be predicted by the kinetic theory of gases if no mixing is done by an external agent. This may be applied to the gases of the atmosphere. Determinations of the composition of air samples taken from the stratosphere by means of a light collecting apparatus carried up by a sounding balloon have proceeded from 1935. Results show that up to 18 km. no change is found in the chemical composition of the air, but at 21 km. the relative amount of He is increased. The differences from the proportions existing in the troposphere are less than would occur in a perfectly still atmosphere. This means that there are no sudden changes in the condition of the stratosphere at that height. A table shows the variation with height in He and O_2 content so far determined. A. E. M. G.

2008. Diurnal Variation of Temperature in the Stratosphere. K. Wegener. *Gerlands Beitr. z. Geophys.* 49. 4. *pp.* 427–430, 1937.—The diurnal variation of the temperature in the stratosphere is 0·5° C. AUTHOR.

2009. Dry-Type Moisture Discontinuities. J. Namias. *Monthly Weather Rev.* 64. *pp.* 351–358, *Nov.,* 1936.—From theoretical principles and observed data the author attempts to show that there is a radiative governing mechanism in these discontinuities. The quantitative treatment of dry inversions for an unsaturated moist base with an overlying relatively dry stratum is carried out first. In this case it is shown that the maintenance of static equilibrium is not sufficient to produce the pronounced stability observed. The radiative transfer across the discontinuity surface is therefore examined, use being made of the work of Brunt and Simpson. The author next deals with the case when clouds are present. These are regarded as behaving like black bodies. This alters the relation used in the first case between the upward and downward radiations from the layer. In a discussion of the synoptic importance of equilibrium, reasons are given why conditions at first favourable for thunderstorms become less favourable and why surfaces of subsidence may be appreciably modified by radiation influences. A. E. M. G.

2010. Long-Period Weather Changes and Forecasting. H. H. Clayton. *Monthly Weather Rev.* 64. *pp.* 359–376, *Nov.*, 1936.—The author deals first with the bases of the forecasts. Weather phenomena are analysed into periods of different lengths. This is done for every station in a network and values plotted on charts. From a succession of these charts one can follow the areas of excess and deficiency of the various elements. Also the correlation between the waves of the meteorological elements and those of solar radiation can be established in the same way. In the second section which deals with methods of forecasting, the projection of these waves into the future is considered. For this purpose the mean lengths of the solar periods as determined by experience or calculation are employed. This process is carried out for a number of stations, the results plotted on a chart and lines of equal value for the meteorological elements drawn. These charts become a forecast for the area considered. The smoothing processes used in the method are discussed in the third section. The paper is illustrated by a large number of line diagrams. A. E. M. G.

2011. Convectional Circulation and its Relation to Land and Sea Breezes. T. Kobayasi, T. Sasaki and T. Osanai. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 145. [67 *pp.*] *Feb.*, 1937. *In English.*—A description is given of experiments carried out with water in a tank where one half of the bottom of the tank is warmed, the other half kept at constant temperature. The circulation obtained is photographed, and the results derived discussed. A mathematical investigation of the motion of a fluid where one half of the bottom of the fluid is heated, is then carried out. The solution so obtained is thereafter applied to the tank experiment. It is found that the mathematical solution accords well with the results of the experiment when a suitable value is given to the diffusibility of temperature in a vertical direction and when the effect of viscosity is taken into account. In the case of land and sea breezes the solution indicates the relations of the rising of temperature of the land to the wind velocities at various points and times and also the limiting height of the breeze and the speed of the extension inland of the region affected by the breeze. A. E. M. G.

2012. Nature of Snow. G. Seligman. *Roy. Inst., Proc.* 29. 3. *pp.* 463–483, 1937.—A note by Bragg on the crystal structure of ice obtained by X-ray analysis is given first. Descriptions are supplied of the types, growth and firnification of snow flakes and of film crust. Conditions for the formation of avalanches are described and illustrated by photomicrographs. The effect of wind packing and the formation of sastrugi and

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wind slabs are detailed. Finally, the formation of rime and of various types of hoar frost are described. R. S. R.

2013. Theory of Scattering and Absorption of the Radiation Energy in the Atmosphere. A. N. Gordov. *Gerlands Beitr. z. Geophys.* 49. 4. *pp.* 373–386, 1937.—Consideration is given by a numerical method to the influence of certain parameters in the formula obtained earlier [see Abstract 4609 (1936)] on the characteristic values for the balance of solar energy in the earth's atmosphere. Some auxiliary problems are discussed including the cause for the maximum of diffused radiation when the turbulence of the atmosphere increases. The diurnal variation of diffuse radiation obtained by calculation is compared with observed values. R. S. R.

2014. Production of Auroral and Night-Sky Light. S. Chapman. *Phil. Mag.* 23. *pp.* 657–665, *April,* 1937. *Supplement.*—A theory of the mechanism of the production of the night-sky light is put forward. It is considered that the energy involved is originally derived from sunlight, being stored up during the day mainly in the form of dissociation of O_2 molecules. The author outlines the ways in which the different observed lines and bands of the night-sky spectrum could be excited by the recombination of O atoms, the third particle necessarily participating being a nitrogen molecule or another oxygen atom and more probably the former. The auroral spectrum, on the other hand, is attributed to strong excitation by impact due to high-speed particles, whether ions or electrons, entering the atmosphere from outside. The presence of lines of atomic N is considered to be very doubtful. L. A. W.

See also Abstracts 2142, 2274.

SEISMOLOGY.

2015. Moon and Earthquakes. R. Spitaler. *Gerlands Beitr. z. Geophys.* 49. 3. *pp.* 296–297, 1937.—The data in the "International Seismological Summary" are examined, and it is concluded that the moon exerts no influence on the occurrence of earthquakes. W. A. R.

2016. Japanese Earthquakes. R. Spitaler. *Gerlands Beitr. z. Geophys.* 49. 3. *pp.* 298–300, 1937.—The data are examined for the presence of a 6-year cycle. Whilst there is evidence of a cyclic course the present data do not allow of an exact determination. W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2017. Summary of the Year's Work, Department of Terrestrial Magnetism, Carnegie Institution of Washington. J. A. Fleming. *Terr. Mag.* 41. *pp.* 363–373, *Dec.,* 1936.—The report refers to the year July 1, 1935 to June 30, 1936. The following standard types of cycles are now recognised; persistence in the solar- and lunar-diurnal variations of terrestrial magnetism, persistence in the semi-annual wave of magnetic activity, quasi-persistence in the 27-day tendency in recurrence of magnetic disturbance due to the sun's rotation. The asymmetry of the intensity-distribution of cosmic radiation round the earth's equator must be related to a similar feature in the magnetic field, and it is pointed out that H varies on the magnetic equator from 0·40 in Siam to 0·28 in S. America. The earth's field has been usefully represented by an eccentric dipole displaced 342 km. from the geometric centre, and external current systems have been constructed; the total current flowing outside the earth on days of moderate disturbance is estimated at 750,000 A. An investigation of short-time magnetic disturbances, called bays, was undertaken. These are usually of about one hour's duration and are manifested simultaneously all over the earth. A universal type of magnetometer is being developed for rapid and accurate measurement of the earth's magnetic field. The design of a new primary standard for H, F, Z, D and I has also been carried out which will have an absolute accuracy of about 1 in 100,000. In terrestrial electricity, the stratosphere flight brought out that, at 18 km. altitude, air conductivity is 100 times greater than at the surface of the sea. It is surmised that the recombination coefficient for small ions varies nearly as the one-half power of the pressure. Earth currents apparently circulate in the crust in a number of extensive eddies, eight of which are located in middle latitudes. Observation of the ionosphere by radio waves shows that the maximum daily ion-density of the highest region occurs during the same time of year in both northern and southern hemisphere. Downcoming radio waves are polarised in perpendicular planes, as predicted by theory. An equipment has been completed for recording, continuously and automatically, changes in the ionosphere with time, over the necessary frequency range. In nuclear physics a physical force was directly observed and measured for the first time, namely the attractive force which binds protons and neutrons together to form atomic nuclei. When the distance between a pair of protons is extremely small, this attractive force predominates over the electrical repelling force, and the attractive forces between a pair of protons, a pair of neutrons, and a proton and neutron are identical. Details are also given of the observatory and oceanographical work of the department. [See Abstract 1153 (1936)]. G. E. A.

2018. Permanent Magnetisation of Basalt. É. Thellier. *Comptes Rendus*, **204.** *pp.* **876–879,** *March* **15, 1937.**—Tests made on samples of basalt inclined in a definite direction in the earth's magnetic field for three days showed changes in the magnetisation, and similar results were obtained in laboratory tests, indicating the presence of remanent magnetism in the samples. This property is assumed to be due to the mineralogical composition of the basalt (magnetite). [See Abstract 5495 (1936).] **R. S. R.**

See also Abstract **2275.**

RADIOACTIVITY.

2019. Quantisation of Theories of β-Disintegration. M. Fierz. *Helv. Phys. Acta*, 10. 2. *pp.* 123–129, 1937. *In German.*—It is shown that in the terms for a Lorentz-invariant theory of the β-disintegration, in which the Fermi matrix elements contain derivatives of the wave function according to position coordinates, no field quantisation corresponding with the Pauli exclusion principle, is possible. This is already the case if linear magnitudes only are considered in the constants characteristic of the β-disintegration, and $g^2 = O$. C. A. S.

2020. Fermi Theory of β-Disintegration. M. Fierz. *Zeits. f. Physik*, 104. 7–8. *pp.* 553–565, 1937.—The points dealt with are: (*a*) the reduction to five of the invariant terms for the matrix element of the β-disintegration which contain no derivatives of the wave functions; (*b*) the form of the β-spectrum, resulting in a general expression, a linear combination of the five invariants; (*c*) the force between proton and neutron; and (*d*) the magnetic moment of the neutron. [See Abstract 5136 (1936).] C. A. S.

2021. Relations in β-Ray Transformations and the Neutrino Theory. H. O. W. Richardson. *Nature*, 139. *pp.* 505–506, *March* 20, 1937.—In order to predict the shape of the curve expressing the energy distribution of the electrons emitted in radioactive transformations, several formulae have been proposed, based on the theory that (unobservable) neutrinos are simultaneously emitted. It is pointed out that the equation of Fermi fits low-energy transformations, whilst that of Konopinski-Uhlenbeck applies in the case of high-energy electrons.

2022. Precise Measurement of Three Radium-B β-Particle Energies. F. T. Rogers Jr. *Phys. Rev.* 51. *p.* 588, *April* 1, 1937.—Corrections of the values of e/m_0, etc. given in the original articles. [See Abstract 4633 (1936).]

2023. Coincidence Measurements for the β- and γ-Rays of RaC. W. Bothe and H. Maier-Leibnitz. *Zeits. f. Physik*, 104. 7–8. *pp.* 604–612, 1937.—Single energy regions of the nuclear β-radiation of RaC have been magnetically separated and it has been established to what degree these electrons temporarily coincided with γ-quarta. It is indicated that with increasing electronic energy the coinciding fraction decreased and vanished entirely at about 2 eMV, while the β-spectrum itself attained 3·15 eMV. This result is not in agreement with the data for the terms of the RaC^1-nucleus as derived by the Ellis and Oppenheimer from the γ-spectrum of RaC and the α-spectrum of RaC^1. It must in consequence be assumed that a considerable probability arises that the transformed RaC-nucleus is immediately in the ground state. Experimental details are included. H. H. Ho.

2024. Ionisation by γ-Rays in Air at High Pressure at Various Temperatures. J. Clay, H. J. Stammer and M. van Tijn. *Physica*, 4. *pp.* 216–220, *March*, 1937. *In English.*—Ionisation currents from γ-rays in air at high pressures (to 152 atmos.) for a range of 5000 to 10 V per cm. and for temperatures ranging from 20°–50° are measured. There is no influence of temperature on the saturation value. AUTHORS.

2025. Rate of Emission of γ-Ray Energy by Ra (B + C) and Th (B + C″). L. H. Gray. *Roy. Soc., Proc.* 159*A. pp.* 263–283, *March* 15, 1937.—The total ionisation that would be produced by complete absorption of γ-radiation has been measured experimentally, by means of small Al chambers, at 2–50 cm. distance from Rn and RaTh sources, placed at the centre of a large block of Al absorbing all but 1 % of the γ-ray energy. A value of $N = 1\cdot 90 \times 10^{15}$ ions/gm./sec.; corresponding to an energy emission of 8·75 cal./gm./hr. was found for Ra(B + C) while the value determined for Th(B + C″) was $N = 1\cdot 88 \times 10^{15}$ ions/gm./sec. or 8·7 cal./gm./hr. when 33·5 V/ion pair was assumed to be the average energy lost by the secondary electrons. Although the shape of the absorption curve of the ThC″ γ-rays is approximately what would be expected, the absorption curve for the Ra(B + C) γ-rays indicates that the relative proportion of the hard radiation in the spectrum is markedly greater than that estimated by Ellis and Aston. Using calculated values of σ_a the scattering absorption coefficient in the wall material of the chamber, the value found for the energy, according to the theory given previously [see Abstract 5088 (1936)], is in close agreement with the experimental value. It is concluded that the experiments provide a verification of the Klein-Nishina formula for σ_a for an average wavelength of about 10 X.U. T. A. C.

2026. Energy and Absorption of the γ-Radiation from $Li^7 + H^1$. L. A. Delsasso, W. A. Fowler and C. C. Lauritsen. *Phys. Rev.* 51. *pp.* 391–399, *March* 15, 1937.—From a study of the pairs ejected from foils in a Wilson cloud chamber, the γ radiation from $Li^7 + H^1$ is found to consist of a line at 17·1 ± 0·5 eMV of relative intensity 0·75 and probably one or more lines at abour 14 eMV of relative intensity 0·25. No radiation is found between 2 and 10 eMV and the spectrum below 2 eMV has not been investigated. The distribution of recoil electrons is consistent with this and with the Klein-Nishina formula. The division of energy between members of pairs is in agreement with the predictions of Bethe and Heitler. Counting the number of high energy pairs taken alternately with and without 1 cm. of lead in the beam leads to a value of the absorption coefficient which agrees with theory. The origin of the radiation is discussed and it is shown that the data can be accounted for if we assume that the proton is captured by the Li^7 nucleus producing a Be^8 nucleus in an odd state. F. C. C.

***2027. Efficiency of γ-Ray Counter. H. Yukawa and S. Sakata.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 686. *pp.* 187–194, *March*, 1937. *In English.*—The efficiency, *i.e.*, the probability of the electric discharge per quantum, of the thick-wall γ-ray counter is computed by making various simplifying assumptions for several energies between 0·2 and 5 eMV in the case of Al and between 1 and 10 eMV in the case of Pb. The efficiency of the thin-walled counter is also discussed. AUTHORS.

See also Abstracts 1869, 1875, 2051, 2080, 2081, 2082, 2214, 2247.

RADIATION.

ABSORPTION AND TRANSMISSION.

***2028. Glass Colour Filters for Special Applications. H. P. Gage.** *J.O.S.A.* 27. *pp.* 159–164, *April*, 1937.—The spectrophotometric data for one thickness of a glass is sufficient for calculating these data for any other thickness by a method here described, using either an ordinary slide rule or a special table. Calculation is made of the thickness required of two special glasses used in combination, one yellow, the other a new type of blue green, for correcting the spectral response of a photronic cell to the spectral luminosity response of the eye. AUTHOR.

See also Abstract 2069.

COLORIMETRY.

***2029. Spectrophotometry in Colorimetry. M. G. Mellon.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 51–56, *Feb.* 15, 1937.—The author describes very briefly a number of visual and photoelectric spectrophotometers and their application in what chemists term colorimetry. The conversion of data from a spectrophotometer to the specification of colour on a trichromatic basis is mentioned. W. S. S.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2030. Kerr-Constant of Gases in Relation to Density. S. Oka. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 156–160, *Feb.*, 1937. *In German.*—As an addition to Kubo's theory of the molecular polarisation of gases a formula has been derived for the Kerr constant of gases at high pressures, by inserting a correction in the dipole term to account for the interaction of the dipoles. This term is zero for non-polar gases, for which the formula of Langevin and Bern is always valid, confirmation being afforded by measurements on CO_2, CH_4, C_2H_6 and C_2H_4. For polar gases, however, no measurements are yet available for testing the above theory. H. H. Ho.

2031. Paramagnetic Rotatory Polarisation. J. Becquerel and W. J. de Haas. *K. Onnes Lab., Leiden, Comm. Nos.* 241–252. *Suppt. No.* 81*a* [11 *pp.*], 1936. *In French.*—Amplification of previous work [see Abstracts 1817 (1930) and 3243 (1934)]. It is found that a molecular field enters into the expression for the rotation, and that a paramagnetism independent of the temperature is superposed on the paramagnetism which is a function of the temperature. In the uniaxial crystals hitherto examined the paramagnetic rotatory power has increased as the temperature fell. In siderose, at He temperatures T, the rotation is very small, and is independent of T. In two specimens of this crystal from different sources, the thermal variations of the rotatory power while exhibiting similar general features differ in detail. This is attributed to a difference in structure which is sufficient to cause a difference in their crystalline fields. The theory of van Vleck and Hebb, [see Abstract 3244 (1934)], according to which the rotation is proportional to the magnetisation, was verified for temperatures from that of air downwards for ethyl sulphates of Pr, Nd, Er and Dy. This enables the susceptibilities along the axis to be calculated from purely polarimetric measurements. [See also Abstract 610 (1937).] G. E. A.

2032. Magneto-Optical Dispersion of Iso-amyl Acetate, Methyl Iso-valerate, and Acetone. Beryl P. M. Walters and E. J. Evans. *Phil. Mag.* 23. *pp.* 791–806, *April*, 1937. *Supplement.*—The magneto-optical and refractive dispersions of these compounds at wave-lengths in the violet and near ultra-violet can be represented respectively by means of equations with a single variable term, in which the value of the characteristic wave-length is the same for either property. The value of e/m deduced from the measurements is about 1×10^7 e.m.u. C. B. A.

2033. Magneto-Optic Method of Analysis. D. C. Bond. *Am. Chem. Soc., J.* 59. *pp.* 439–444, *March*, 1937.—Definite evidence is presented for the existence of an objective effect in the Allison apparatus. Results are obtained which indicate that this effect is caused by the presence of a particular compound, vanishing when the concentration of the compound is reduced to a very small value. However, the latter has not been proved conclusively. Certain experiments are described which give some information about the properties of the magneto-optic apparatus. A partial theoretical explanation for the Allison effect is presented. AUTHOR.

See also Abstracts 2040, 2041, 2042.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2034. Fluorescence of Hg Vapour Produced by Double Excitation. A. Kastler. *Acta Physcia Polonica*, 5. *pp.* 59–62; *Disc.*, 62–63, 1936. *In French.*—In the presence of N_2 the 4046 fluorescence line of Hg is polarised positively, the 4358 negatively. In pure Hg the fluorescence is diminished and the polarisation reversed. This is explained by the Zeeman structure of the rays. In the first case, the intermediate state is 7^3S_1, which is little perturbed by collision or a magnetic field. In the second case, both the 6^3P_1 and 7^3S_1 states are concerned. The 6^3P_1 state is very susceptible to collison or a magnetic field. Separate polarisation of each of the exciting rays allows of all the theoretical cases being isolated. H. G. C.

2035. Excitation of the Bands of CuCl by Fluorescence in the Vapour of Cuprous Chloride. J. Terrien. *Comptes Rendus*, 204. *pp.* 565–567, *Feb.* 22, 1937.—The line spectrum given by the spark between metal electrodes (Zn, Cd, Al, Cu) was focused in the interior of the vapour of CuCl and the fluorescent light emitted at right angles to the incident light was focused on the entrance slit of a spectrograph. In this way the fluorescent spectrum given by each of the exciting monochromatic radiations was photographed. The five known systems of bands in the visible given by CuCl were found to be excited by all rays of wave-length less than 2370 Å, the intensity of fluorescence being maximal for an exciting radiation of 2250 Å. This identifies the excitation of fluorescence with the continuous band of absorption previously observed [see Abstract 2504 (1935)]. The relative intensities of the five fluorescent bands were found to vary slightly with the exciting wave-length. It is suggested that fluorescence occurs by the absorption of a single quantum by the polymerised molecule Cu_2Cl_2 with the production of a normal and an excited molecule CuCl. W. S. S.

2036. Fluorescence and Phosphorescence of Adsorbed Dyestuffs. P. Pringsheim. *Acta Physica Polonica*, 5. *pp.* 361–374; *Disc.*, 374–376, 1936. *In German.*—An exhaustive discussion of the properties of the fluorescence of dyestuffs adsorbed in various gels. The existence of the solid phase introduces three important factors, increased shielding of the dyestuff molecules against distortion, lowering of mobility sometimes to the point of total fixation, and increase of ordered arrangement. The first effect may lead either to a quenching of the light even to extinction or, in those cases where quenching is produced by exchange effects with the surrounding solvent molecules, may lead to a very marked decrease in this quenching so that many substances which show no trace of fluorescene in liquid solution are brilliant in solid adsorbates. In this connection the effect of oxygen quenching of phosphorescene of gels of various fineness of structure is discussed with reference to Kautsky's experiments on trypaflavin gel phosophors. Experiments are also described showing directly the shielding effect of the gel against quenching collisions. The second effect is discussed with reference to the consequent polarisation effects. The effect of the ordered or partly ordered arrangement of the solid phase on the polarisation of the light from the adsorbed dyestuff molecules is also discussed in detail. J. E.

2037. Decay of Fluorescence of Dyestuff Solutions. F. Duschinsky. *Acta Physica Polonica,* 5. *pp.* 255–269, 1936. *In German.*—A survey of the methods used to determine the time decay of the fluorescence of dyestuffs in solution. The various mechanical phosphoroscopes are mentioned and a detailed account of the construction and use of the Gaviola fluorometer. This employs two Kerr cells side by side actuated by the same h.f. potential. The light passing through one falls on a mirror inclined at 45° and then on another mirror close to the first which reflects it back through the second cell. If the cell-mirrors-cell distance is an odd multiple of the half wave-length of the h.f. oscillation then obviously no light will pass the second cell. In general the intensity of light passing is a function of the cell-mirror distance. If the first mirror is replaced by the substance investigated the intensity through the second cell is also determined by the time decay of the substance. By obtaining intensity-distance curves in both cases the time decay can be evaluated. Other methods of the indirect kind are depolarisation, parallelism between output and time decay, quenching by foreign substances, quenching by concentration, and Jablonski's method of investigating the decay curves in various directions with respect to the electric vector of the exciting polarised light [see Abstract 2966 (1935).] J. E.

2038. Growth and Decay of Fluorescence of Vapours. W. Kapuściński. *Acta Physica Polonica,* 5. *pp.* 39–52; *Disc.,* 52–58, 1936. *In German.*—A discussion of the present position in this field, with special reference to Hg and Cd vapours. A. C. M.

2039. Extinction of Fluorescence in Liquid Solutions. S. I. Wawilow. *Acta Physica Polonica,* 5. *pp.* 417–431, 1936. *In German.*—No comprehensive theory has yet been developed to cover the complex phenomenon of the extinction of fluorescence in liquid solutions. It has however become possible to dissect the phenomenon in a rational manner and to provide a theoretical basis for observations in some special cases. The paper comprises a survey of the theories principally due to Perrin, Lewschin, Frank and the author which have recently been applied with some success. Experimental observations of the extinction of fluorescence of rhodamin-B solutions are quoted in illustration of theory. J. E. K.

2040. Influence of a Magnetic Field on the Fluorescence of Diatomic Molecules. S. Pieńkowski. *Acta Physica Polonica,* 5. *pp.* 127–149; *Disc.,* 149–150, 1936. *In French.*—A general discussion of the influence of a magnetic field on the fluorescence of diatomic molecules and related phenomena, *e.g.*, predissociation. H. G. C.

2041. Polarisation of Fluorescence, and Effects of Electric and Magnetic Fields. W. Hanle. *Acta Physica Polonica,* 5. *pp.* 21–37; *Disc.,* 37–38, 1936. *In German.*—Consists of a review of the subject. The following matters are dealt with: (1) Linear polarisation, and the influence of a magnetic field applied to it, including anomalous splitting, hyperfine structure, effect of very weak and of very strong fields, and the determination of the time during which the light lasts by means of polarisation measurements: (2) Reversal of linear polarisation (negative) polarisation: (3) Circular polarisation and its reversal: (4) Depolarisation through collisions: (5) Electrical effect: (6) Polarisation of molecular fluorescence: (7) Polarisation of fluorescence from liquids and solids. A. C. M.

2042. Polarisation of Fluorescence of Diatomic Vapours and Influence of Collisions. S. Mrozowski. *Acta Physica Polonica,* 5. *pp.* 85–104; *Disc.,* 104–107, 1936. *In German.*—This paper comprises a review of the progress made in the last few years towards providing a theoretical interpretation for the most significant observations of the polarisation of fluorescence of diatomic vapours. The principal topics discussed are the effect of weak magnetic fields on the polarisation of diatomic band fluorescence, the depolarising effect of collisions between molecules of the fluorescing vapour, the depolarisation of fluorescence particularly of I_2 vapour by collisions with admixed gas molecules, and the polarisation of fluctuation bands of Hg_2, Cd_2 and Zn_2. Particular reference is made throughout the review to cases of conflict between theory and experiment and to problems which still await solution. J. E. K.

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2043. Characteristic Parameters of Polarisation in Fluorescence and their Applications. P. Soleillet. *Acta Physica Polonica,* 5. *pp.* 207–213; *Disc.,* 213–214, 1936. *In French.*—An investigation of the minimum number of parameters necessary for the complete description of a fluorescence phenomenon. The general case is very complex, but in the case of an isotropic medium (no magnetic field) the number for simple fluorescence is 3 and for fluorescence by excitation by steps is 11. H. G. C.

2044. Optical Properties of Molecules in Solid and Liquid Solution. A. Jabłoński. *Acta Physica Polonica,* 5. *pp.* 271–284; *Disc.,* 285–287, 1936. *In German.*—A theoretical discussion mainly concerned with the fluorescence of dyestuff molecules in solution. Questions of intensity distribution in absorption and emission and the relation between them and the polarisation effects are treated from the wave-mechanical point of view. J. E.

2045. Fluorescence of Cyclohexane. S. M. Mitra. *Phil. Mag.* 23. *pp.* 558–562, *April,* 1937.—The fluorescence of cyclohexane subjected to continuous distillation and in closed tubes as excited by light from a Hg arc consists of an intense band with a maximum at 2,900 Å and a feebler band at 4,000 Å. The first is very sensitive to temperature being a maximum at 16° C, but is independent of exposure to u.v. light. It is probably due to cyclohexane. The second is less sensitive to temperature, but is increased in intensity and broadened by exposure to u.v. light. It is attributed to a product of photodecomposition. Exposure to u.v. light produces a white powder which in solution gives a fluorescence band at 4,000 Å. H. G. C.

2046. Decay of Phosphorescence and Mechanism of Emission. W. L. Lewschin. *Acta Physica Polonica,* 5. *pp.* 301–317, 1936. *In French.*—A monomolecular process of emission leads to an exponential law while a bimolecular process, implying the separation of an electron from a centre, leads to a hyperbolic law of the second degree, $I = a/(b+t)^2$. The recent researches of Wawilow and the author as well the results of Nichols and Merritt show that the decay of the uranyl salts is strictly exponential corresponding therefore to a monomolecular process of emission. Experiments are here described, as performed by the author and others, on the decay of ZnS phosphors and on the variation of intensity with excitation. In the later stages the decay follows a hyperbolic law of the second degree, indicating a bimolecular process (separation of electron). This should give rise to a linear relation between the exciting intensity squared and the resulting emission intensity. This result has been found. In the case of the phosphors, made by incorporating small amounts of organic substances in boric acid and in $Al_2(SO_4)_3$, 18 H_2O, the decay is found to be exponential indicating a monomolecular process of emission in these cases. J. E.

2047. Lenard Phosphors. R. Tomaschek. *Acta Physica Polonica,* 5. *pp.* 393–406; *Disc.,* 406–408, 1936. *In German.*—A review of the present position with regard to the phosphorescent spectra emitted by Lenard-phosphors. Specially dealt with are: the relationship between the spectra observed and the atomic term-scheme of the metallic impurity, rare-earth phosphors, and the effect of the lattice-vibrations of the material on spectra emitted. A. C. M.

2048. Excitation of Gelatin-Dyestuff Phosphors. P. Fröhlich and Z. Gyulai. *Zeits. f. Physik,* 104. 7–8. *pp.* 549–552, 1937.—These phosphors have a much stronger phosphorescence after a long dosage of strong white light. This enhanced state lasts several hours after the preliminary dosage and is markedly dependent in its magnitude on the concentration, reaching a maximum effect at a definite concentration range. The ratio of enhanced emission to normal emission decreases exponentially with time. The enhancing spectrum appears to coincide with the normal exciting spectrum. J. E.

2049. Luminescence of Flames. V. Kondratjew. *Acta Physica Polonica,* 5. *pp.* 65–77, 1936. *In German.*—Thermoluminescence is first considered and it is concluded that the specific property in the absence of a selective emission consists of a proportionality between intensity and pressure. Chemiluminescence is treated more fully, the heat emission of a number of reactions being given, and the significance for chemical kinetics being considered. F. S.

2050. Photoluminescence of Gaseous Organic Molecules. A. Terenin. *Acta Physica Polonica,* 5. *pp.* 229–253, 1936. *In French.*—A review of the subject. The matter is grouped as follows: 1. Aliphatic substances, and the special importance of the C = O group. 2. Aromatic substances, and the special importance of the benzene ring. 3. Benzaldehyde, which contains both a benzene ring and a C = O group. 4. Special topics, such as influence of temperature change. A. C. M.

2051. Radio Photoluminescence. K. Przibram. *Acta Physica Polonica,* 5. *pp.* 377–380, 1936. *In German.*—A brief review of what is known about radiophotoluminescence. In particular, reference is made to Jantsch's experiments proving that the luminescence of fluorite is partly due to the radiophotoluminescence of Eu inclusions. Alkali halides into which

Eu is introduced show blue fluorescence after strong heating. Further, precipitation of CaF_2 in presence of Eu gives a product which shows after radium dosage, the fluorite blue band, and after heating also the red band due to Sm II. It is considered that rare-earth luminescence is always attributable to mono, bi- or tri-valent excited rare-earth ions. J. E.

*2052. **Luminescence and Its Applications. J. T. Randall.** *Roy. Soc. Arts, J.* 85. *pp.* 354–381, *March* 5, 1937. *Electrician,* 118. *p.* 183, *Feb.* 5, 1937.—After explaining the meaning of the term luminescence and indicating the differences between fluorescence and phosphorescence the author deals with the subject under the following headings: Historical outline; classes of luminescent materials; chemi-luminescence and bio-luminescence; spectra of luminescent materials; phosphorescence; effect of temperature; flame luminescence; thermo-luminescence; electrical properties of luminescent solids; theory of luminescence; applications of luminescence. In the last section the detection of fraud and the application of luminescent materials to X-ray work are briefly illustrated, the main considerations being the application of such materials to gas and vapour discharges and kathode-ray tubes. R. C. F.

See also Abstracts 2006, 2092, 2277.

INTERFERENCE, DIFFRACTION AND SCATTERING.

2053. Rowland Ghosts. H. G. Gale. *Astrophys. J.* 85. *pp.* 49–61, *March,* 1937.—A number of small diffraction gratings have been ruled containing arbitrary errors. It is shown that a small sine error $a_1 \sin \theta$ produces ghosts the intensity of which depends upon the ratio of a_1 to a_0, the average grating space, and the order N, in complete agreement with Rowland's theory. Small periodic errors may be applied simultaneously, and each will produce a ghost corresponding to its period. When the errors are small, the ghosts appear at the expected places, and the shape of the error curve may be interpreted from the positions and strength of the ghosts.

2054. Dark Bands in the Spectra from Acoustical and Optical Double Gratings. R. Bär. *Helv. Phys. Acta,* 10. 2. *pp.* 130–138, 1937. *In German.*—The dark bands observed by Cermak and Schoeneck [see Abstract 3603 (1936)] when light passes through two gratings in series are examined. The bands are due to "interferences of equal inclination" between light beams which, after diffraction by the gratings, emerge in the same direction. The bands, in agreement with theory, are formed both by stationary waves and by parallel progressive waves. They are not produced by antiparallel progressive waves, but are visible when the ratio of the grating constants is a simple one. G. E. A.

2055. Selective Scattering of Light in Mercury Vapour. G. Landsberg and L. Mandelstam. *Acta Physica Polonica,* 5. *pp.* 79–84, 1936. *In German.*—The selective scattering of the line 2558 Å in Hg vapour is investigated and a method is indicated which, with the aid of the quenching due to H_2, permits determination of the contribution of atoms to the total scattering. The measured atomic scattering is found to be in good agreement with theory. It is found that the intensity of scattering is proportional to the vapour density. Measurement of the intensity variations of the lines 2558 and 2502 Å confirms the selective nature of the scattering. The molecularly scattered radiation is only weakly polarised, that scattered by atoms is almost completely polarised.

The dependence of molecular light intensity on pressure of admixed H_2 can be expressed by the Stern-Volmer formula. N_2 has only a small quenching effect. J. E. K.

2056. Scattering of Light by Electric Fields in the Theory of the Positron. N. Kemmer. *Helv. Phys. Acta*, 10. 2. *pp.* 112–122, 1937. *In German.*—In Dirac's theory of the positron light should be scattered by strong electric fields. This scattering is calculated for the case in which the frequency of the light is small compared with mc^2/h (m = electronic mass, c = light velocity, h = Planck's constant) and in which the relative variation of the electric field over distances of the order h/mc is small. R. P.

2057. Anomalous Depolarisation and Mie Effect at Critical Opalescence. V. S. Vrkljan. *Acta Physica Polonica*, 5. *pp.* 409–414; *Disc.*, 415–416, 1936. *In German.*—The two rival theories of the scattering of light by liquids at critical opalescence are discussed, one of which gives a λ^{-4} law for the scattering with symmetrical distribution of intensity and polarisation and the other of which gives a λ^{-2} law and an asymmetrical intensity distribution (Mie effect). Experimental tests of these theories are surveyed and it is concluded that they do not permit a definite decision as to which theory is correct. Consideration is next given to the questions as to whether molecular swarms or molecular complexes exist in liquids and if so whether their presence might be detected by light scattering experiments. Krishnan has shown that molecular complexes should give rise to a Mie effect but his own experiments and those of Rousset are by no means in harmony with theory and leave the problem to be settled by more decisive experiments. Very recently Gans has put forward a theory in explanation of the results obtained by Krishnan on the scattering of light by the first four members of the fatty acid series and has predicted a depolarisation effect of the molecular complexes which should be capable of experimental detection. J. E. K.

2058. Dispersion of Depolarisation of Light Scattering in Gold Sols. R. S. Krishnan. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 94–107, *Jan.*, 1937. —Measurements are reported for the dispersion of polarisation of the light scattered traversely by a series of six Au sols, from 2500 to 7000 Å. The depolarisation factors ρ_u and ρ_v (unpolarised and polarised vertically, respectively) and the extinction coefficient are observed, and ρ_h (light polarised horizontally) is deduced from ρ_u and ρ_v. There is an enormous increase in the depolarisation factors in the region of characteristic absorption. The optical anisotropy of the Au particles in the colloidal state is rather low in the shorter wave-length region, while it rises to higher values in the green region where the absorption is a maximum. It is inferred that Au particles behave optically like elongated ellipsoids with an axial ratio of about $\frac{1}{2}$. The values of ρ_h indicate that the particles are small in the nuclear sols, but in the blue sols they are comparable in size with the wave-length of the blue light. The negative streaming double-refraction and its dispersion with wave-length, observed by earlier investigators, are explained in terms of the elongated ellipsoidal shape of the particles and the dispersion of their optical anisotropy. A. C. M.

***2059. Theory of Interference Apparatus. A. Bogros.** *J. de Physique et le Radium*, 8. *pp.* 88–92, *March*, 1937.—A comparison of spectroscopic instruments which depend on the interference or diffraction of radiation and are geometrically similar shows, by a simple argument, that in the case where the fringes are observed at a finite distance the linear dispersion for a given radiation is proportional to the dimensions of the apparatus. In the case where the fringes are observed at infinity the angular dispersion is independent of the dimensions of the apparatus. In both cases, however, the dispersion counted in fringes and the power of resolution are proportional to the dimensions of the instruments. These remarks permit of the correlation of known results obtained with different spectroscopic instruments, and can facilitate the study of certain particular cases, such as that of the fringes due to layers of air of different thicknesses. G. O. B.

See also **Abstract 1967.**

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2060. Primary Process of Photodissociation in Sulphur Trioxide. G. Kornfeld. *Faraday Soc., Trans.* **33.** *pp.* **614–617,** *May,* **1937.** —By observing the formation of SO_2 absorption bands in SO_3 irradiated with u.v. light, the decomposition of SO_3 was found to occur with light of wave-lengths longer than 2760 Å. ; this accords with the assumption that the primary process of decomposition results in a SO_2 molecule and an O atom in the normal state. AUTHOR.

2061. Photochemical Reactions in Monolayers. Part I. E. K. Rideal and J. S. Mitchell. *Roy. Soc., Proc.* 159*A. pp.* 206–228, *March* 15, 1937.—The kinetics and technique of examination of photochemical reactions in monolayers are examined and discussed. A summary is given of the theory of light absorption by monolayers. A quartz monochromatic illuminator is described. Photochemical reactions in monolayers are examined by observations of the changes in phase boundary potential on irradiation with monochromatic u.v. light. As a preliminary to a study of proteins, the photochemical behaviour of the CO–NH linkage in relatively simple compounds, especially in those containing an aromatic chromophor, has been examined. The work was started with stearic anilide and the mechanical and electrical properties of monolayers of this substance on strongly acid substrates are described. J. K.

2062. Photochemical Addition of Hydrogen Peroxide to the Double Bond. N. A. Milas, P. F. Kurz and W. P. Anslow, Jr. *Am. Chem. Soc., J.* 59. *pp.* 543–544, *March,* 1937.—It is shown that H_2O_2 under the influence of u.v. light, reacts with double bonded compounds to form the corresponding glycols. Glycerol, dihydroxybutyric acid, mesotartaric acid and diethyl mesotartrate are obtained from allyl alcohol, crotonic acid, maleic acid and diethyl maleate, respectively. The formation of glycols, in the present case, is assumed to take place through the addition to the double bond of free hydroxyl radicals which are formed by the dissociation of H_2O_2 under the influence of u.v. light. AUTHORS.

2063. Graininess of Photographic Materials in Objective Absolute Measure. A. van Kreveld and J. C. Scheffer. *J.O.S.A.* 27. *pp.* 100–109, *March,* 1937.—Describes how all the arbitrary properties of the graininess meter previously described [see Abstract 2686 (1936)] can be eliminated so that an absolute measure, termed absolute graininess, can be obtained, and gives the results of a number of practical measurements made with the meter. The influence of the galvanometer and of the measured area are briefly examined and corrections given whereby the effect of the galvanometer is eliminated completely, it being shown that the absolute graininess is independent of the size of the diaphragm. The meaning of the term absolute graininess is discussed and the correction for the non-linearity of the rectifier dealt with. Results of an examination of 400 images are given, it being concluded from these that the method is applicable both to coarse-grained and to fine-grained emulsions. It is not possible to decide conclusively which developer gives the lowest graininess, the quality of the developer depending to some extent on the emulsion used. In two cases, however, it is found that the developer causes high graininess on a coarse-grained emulsion. R. C. F.

2064. Resolving Power of Photographic Emulsions by Bruscaglioni's Interference Method. V. Ronchi. *Ricerca Scientifica*, 2. *pp.* 622–633, *Dec.*, 1936.—The "grain" of photographic emulsions was studied by projecting a system of interference fringes on the plate and determining the maximum number of fringes per mm. in the developed image which could just be resolved (Bruscaglioni's method). Data illustrating the precision of the method are first given. The effects of the following factors on the resolving power of the emulsion were studied : exposure time, time of development, temperature of development, density of the image. The results are summarised in a series of curves. W. S. S.

***2065. Precision Camera for Testing Lenses. I. C. Gardner and F. A. Case.** *Bureau of Standards, J. of Research*, 18. *pp.* 449–460, *April*, 1937.—Apparatus particularly adapted to the testing of aeroplane camera lenses and complete aeroplane cameras is described. Seven collimators provide optically distant targets spaced five degrees. These targets are photographed by means of the lens or camera to be tested. An examination and measurement of the resulting negative gives the back focal length, equivalent focal length, and both distortion and quality of definition over the entire field of the lens. This instrument was designed and built for making the tests that are required by all contracts for Government mapping projects. AUTHORS.

***2066. "Camera Finish" at the Race Track. I. C. Gardner.** *Bureau of Standards, J. of Research*, 18. *pp.* 467–474, *April*, 1937.—Cameras have been generally installed at race tracks to photograph automatically the finishes of the races. If a race is too close to permit placing the horses by visual observation the judges may use photographs as a basis for their decision. There has been considerable criticism of the camera, and some have questioned the accuracy of the pictures that are obtained. A discussion of possible sources of errors and quantitative appraisal of their importance are given. The conclusion is that relatively simple precautions make the camera a reliable instrument for determining the outcome of a race. In installations that have been examined these precautions have received adequate attention. AUTHOR.

See also Abstracts 2045, 2139, 2140.

PHOTOMETRY.

2067. Precision of Photometric Observations. A. H. Holway. *J.O.S.A.*, 27. *pp.* 120–123, *March*, 1937.—Lowry's results [see Abstract 2257 (1931)] for brightness discrimination are confirmed, his conclusion extended, and his recommendation amplified. The results of the present experiment, for example, show clearly that the root-mean-square departure $\sigma_{\Delta I}$ is directly proportional to ΔI. (This is here called Crozier's law). Moreover, since ΔI is known to vary inversely with the size of the retinal field, the use of a test field which produces a large *retinal* area (central fixation) is to be recommended for increased precision in photometric work. AUTHOR.

***2068. Brightness Meter. M. Luckiesh and A. H. Taylor.** *J.O.S.A*, 27. *p*. 132, *March*, 1937.—Describes a direct vision brightness meter designed to measure the wide range of brightness from ·027 to 53,800 millilamberts. There are two eye-pieces, the upper one for viewing the photometric field, which consists of two silvered rectangles separated by a clear narrow strip, and the lower one for viewing the scale. An image of the object to be measured is brought into focus in the plane of the photometric field in the clear parts, the two silvered rectangles reflecting the image of a diffusing glass in front of the comparison lamp. The brightness of this glass is varied by means of a circular photographic film gradient which is arranged to be easily rotated. Brief details of the use of multiplying and reducing screens are also given. R. C. F.

See also Abstracts 2028, 2029, 2071, 2142.

POLARISATION.

***2069. New Polarisation Filters. M. Haase.** *Zeits. f. techn. Physik*, 18. 3. *pp*. 69–72, 1937.—Describes the results of experiments using the new polarisation filters made of dichroitic crystals, the transmission and degree of polarisation for monochromatic and white light, and the transmission with oblique penetration being dealt with. The two new Zeiss filters—Herotare and Mipolare—are compared and it is found that over a wide spectral range the polarisation is complete. For white light the transmission is approximately 40 % and the degree of polarisation is above 99 %. Using crossed filters it is found that tilting them increases the transmission, and a rotation about the vertical axis shows four positions where the transmission of the crossed filters is a maximum, being still below 1 %, however, even with 50° tilt. R. C. F.

***2070. Rigorous Formulæ for the Brace Compensator. G. Szivessy and W. Herzog.** *Zeits. f. Instrumentenk*. 57. *pp*. 49–60, *Feb*., *and pp*. 89–103, *March*, 1937.—There are two possible arrangements for using the Brace compensator: In the first, the light which is to be studied passes first through the half-shade plate and then through the compensator plate before reaching the analysing nicol prism, while in the second arrangement the order of half-shade plate and compensator plate is reversed. It is pointed out that the formulae describing the two arrangements are quite different, unless the ellipticity of the light is very small. In the literature one finds usually the formulae for the first method, but they are usually stated to apply to the second. Rigorous formulae are given for both cases and it is shown that the second arrangement is much more suitable for measuring the phase difference produced in a doubly refracting substance. R. P.

2071. Photoelectric Determination of Parameters of Elliptically Polarised Light. C. V. Kent and J. Lawson. *J.O.S.A*. 27. *pp*. 117–119, *March*, 1937.—The given beam of elliptically polarised light traverses a phase compensator plate and rotating analyser and enters a photo-cell suitably connected to an amplifier circuit and detecting device. The azimuth γ, of the polariser producing the elliptically polarised light, and ϕ, that of the planes of polarisation of the compensator (or the azimuth ϕ, and α, the phase difference introduced by the compensator) are adjusted until the detector (headphones) shows no modulation of the cell current. Tan γ, the ratio of the components of the elliptically polarised light, and Δ, the phase difference between them, can be calculated from the formulæ:

$\cos 2\gamma = \pm \sin \alpha \sin 2\phi$ and $\cot \Delta = \tan \alpha \cos 2\phi$. The method has been tested in the visible spectrum through a wide range of intensities. The sensitivity increases with the light flux in the cell and is practically independent of stray light. An accuracy of 1 part in 4000 or 5000 or less than 1 minute of arc in azimuthal readings is easily obtained. Polaroid plates can be used instead of nicol prisms with no serious loss in sensitivity. AUTHORS.

See also Abstracts 1913, 1914, 2041, 2042, 2043, 2055, 2057, 2058, 2277.

RADIATION, EMISSION.

*2072. **Radio Transmission of Coincidence Counter Cosmic-Ray Measurements in the Stratosphere. T. H. Johnson.** *Frank. Inst., J.* 223. *pp.* 339–354, *March,* 1937.—The impulses produced by an ordinary coincidence-counting circuit are transmitted; they are lengthened out to a few hundredths of 1 sec. and are thus easily distinguished from atmospherics. The barometric signal is produced by a neon tube flicker circuit whose frequency is controlled by a resistance and a capacity, both of which are varied according to barometric height by means of a series of regularly spaced taps in a mercurial barometer. The transmitter consists of two valves in push-pull with tuned plate and tuned grid circuits. The high potential for the counters is obtained by a condenser multiplying device. For reception a simple super-regenerative receiver has ample sensitivity. The signals are recorded manually, as well as automatically on a moving-film oscillograph. The results of a trial flight are given. The development of balloons made from cellophane, which has for some purposes advantages over an elastic fabric, is described. D. H. F.

2073. **Variation of Unidirectional Cosmic-Ray Intensities with Latitude. T. H. Johnson.** *Am. Geophys. Union, Trans. pp.* 176–178, 1936. *Frank. Inst., J.* 223. *pp.* 379–385, *March,* 1937.—Unshielded counter apparatus giving a continuous automatic record of the cosmic-ray intensity in a vertical direction, and in directions making an angle of 45° with the vertical, was installed in a ship travelling between New York and Valparaiso and back. A greater latitude effect was found than with an electroscope in a 10 cm. Pb shield, and the minimum intensity was found to occur at 5° N. geographic latitude (which is the position of the maximum horizontal magnetic field) instead of at 12° S. geographic latitude. In the readings for directions making 45° with the vertical there was apparently an absence of latitude effect for the westerly direction. Shower readings were also taken, the latitude effect being found to total only about 5 %. The results are discussed individually, and interpretations suggested. [See following Abstract.] D. H. F.

2074. **Unidirectional Measurements of the Cosmic-Ray Latitude Effect. T. H. Johnson and D. N. Read.** *Phys. Rev.* 51. *pp.* 557–564, *April* 1, 1937.—Cosmic-ray intensities in the vertical direction, and in two inclined directions, 45° eastwards and 45° westwards from the zenith, have been recorded as a function of latitude. The apparatus, embodying several coincidence counter trains, was arranged for unattended operation and automatic recording. It has made several voyages between New York and southern Chile through the Panama Canal on ships of the Grace Line. A latitude effect of 12 % was found in the eastern direction compared with 4 % in the western direction. Two values for the vertical latitude effect have been found, one about 12 % and the other about 20 %, and it is uncertain in the present measurements which one is correct. The intensity in the vertical and western directions is strongly influenced by local anomalies in the earth's magnetic field, whereas eastern intensities agree more closely with the distribution expected if the earth's field were that of a dipole. Shower intensities, recorded on one voyage, showed less of a latitude effect than vertical rays. [See preceding Abstract.] AUTHORS.

2075. Counter Measurements of Cosmic-Ray Intensities in Stratosphere. W. F. G. Swann, G. L. Locher and W. E. Danforth. *Phys. Rev.* 51. *pp.* 389–390, *March* 15, 1937.—Data from three different manned balloon flights to the stratosphere are reported. Relative intensities as a function of the distance h below the top of the atmosphere are given for several zenith angles θ. If the intensities for different zenith angles are plotted against $h \sec \theta$ the curves for $\theta = 0°, 30°, 60°$ fall together when $h \sec \theta > 200$ cm. water equivalent, but the intensities for $\theta = 80°$ and 90° are too great to fit in. The variation of the total intensity at different heights was obtained by integrating over all values of θ, and this intensity was found to increase less rapidly with altitude than did ionisation chamber measurements elsewhere reported. Possible explanations are suggested. D. H. F.

2076. Theory of Cosmic-Ray Showers. H. J. Bhabha and W. Heitler. *Roy. Soc., Proc.* 159*A*. *pp.* 432–458, *April* 1, 1937.—On the basis of relativistic quantum mechanics calculation is made of the number of positive and negative secondary electrons produced by a fast primary electron passing through matter. It is considered that the primary electron, on passing close to a nucleus, produces a hard quantum which is ejected in the same direction as the primary electron. This quantum subsequently creates a pair of electrons which are also ejected in the forward direction; this pair produce a pair of quanta which create more pairs of electrons and so on. Shower phenomena are therefore adequately explained on existing quantum theory. The theory accounts for Rossi's transition curve and Regener's absorption curve but the absorption coefficient of the radiation found at a depth of 100 m. of water remains unexplained if the radiation is due to primary electrons. F. C. C.

2077. Meteorological and Magnetic Influences on the Intensity of Cosmic Radiation. Part II. J. Barnóthy and M. Forró. *Zeits. f. Physik,* 104. 7–8. *pp.* 534–539, 1937.—From mean-hour values obtained from a series of measurements extending over more than a year with various methods of measurement the magnitude of the magnetic effect and the temperature effect in cosmic radiation was determined. According to the results of the experiments the day-time period is actually caused by the daily variation of intensity of the earth's magnetic field. The magnetic effect is calculated to be 0·06 % per 10^{-5} gauss. The temperature effect, of the magnitude of 0·1 % per °C. was only found in the group of measurements without lead filter which indicates that it is chiefly to be ascribed to an influence on the weaker scattered rays. [For Part I see Abstract 3620 (1936).] J. J. S.

***2078. N[illegible] Source of Long-Wave Infra-Red Rays. A. M. Lewitskaja.** *Phys. Zeits. d. Sowjetunion,* 10. 6. *pp.* 697–702, 1936. *In German.*—A source in which a MgO antikathode is employed is described. [See Abstract 2486 (1934).] W. R. A.

***2079. Light Sources. R. Rompe.** *Acta Physica Polonica,* 5. *pp.* 151–190; *Disc.,* 190–192, 1936. *In German.*—The author summarises the properties of the different light sources which may be used for researches on absorption and fluorescence. The tungsten-filament lamp, arc lamps, l.p., h.p. and e.h.p. gas-discharge lamps are dealt with in turn. Tables giving the relative energy distribution in the emission of the different lamps and other technical data are included. The mechanism of the emission from discharge tubes is described. Another table gives the appropriate lamp and filter combination to obtain monochromatic light of various wave-lengths ranging from 3076 to 8521 Å. W. S. S.

See also Abstracts 2017, 2080, 2164, 2213.

RADIATION, GENERAL THEORY.

2080. Emission of Light from Pure Liquids Under the Influence of Fast β-Rays. P. A. Čerenkov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 3. *pp.* 101–105, 1937. *In German.*—Using 20 mg. of Ra as source of fast β-rays, an emission of light from several pure liquids is observed which is directly proportional to the energy of the β-rays absorbed. The light is polarised with the electric vector in the direction of motion of the β-rays. The results, which are in good agreement with a theory of Frank and Tamm [see following Abstracts], show that most of the light is produced by electrons of $\beta > 0{\cdot}8$ and that under this condition the intensity is practically independent of the refractive index of the liquid. F. C. C.

2081. Angular Distribution of the Intensity of Light Emitted from Pure Liquids Under the Action of γ-Rays. P. A. Čerenkov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 3. *pp.* 105–108, 1937. *In German.*—The angular distribution of the intensity of the visible radiation emitted from pure liquids as a function of the direction of the incident γ-rays is examined for several liquids. The maximum occurs in a direction ϕ given by $\cos \phi = 1/\beta n$, in agreement with the theory of Frank and Tamm. [See preceding and following Abstracts]. F. C. C.

2082. Coherent Visible Radiation from Fast Electrons Passing Through Matter. I. Frank and I. Tamm. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 3. *pp.* 109–114, 1937. *In English.*—The observations of Čerenkov (see preceding Abstract) on the visible radiation emitted during the passage of fast electrons through matter are explained qualitatively and quantitatively on the assumption that an electron moving with uniform velocity radiates light if its velocity is greater than that of light in the medium traversed. In this case, that is when $\beta n > 1$ where n is the refractive index of the medium, the total energy W radiated by an electron through the surface of a cylinder of length l, whose axis is in the direction of motion of the electron, is given by $W = (e^2 l/c^2)\int w\,dw(1 - 1/\beta^2 n^2)$, where w is a characteristic frequency of a molecule of the medium. In the visible region about 10 photons are emitted by each fast electron. F. C. C.

2083. Intrinsic Properties of Light and Corpuscles from Distant Sources. F. Zwicky. *Nat. Acad. Sci., Proc.* 23. *pp.* 106–110, *Feb.*, 1937.—Discussion on the existence of scientific history, defined as the charge in time of dimensionless ratios of significant physical quantities. The possibility of a difference in the velocity of nebular and terrestrial light is examined from available experimental data. Creation of pairs of electrons by photon-photon interaction would involve non-linearity of Maxwell's equations and this would indicate dependence of velocity of light on frequency. Such an effect could be examined by observation of the times of appearance of lines of different wave-length in the spectra of Novæ. The enquiry might be extended to the detection of differences in the fundamental constants defining corpuscular rays, according to their place of origin. F. C. C.

2084. Polarisation of a Photon and the Spin of the Constitutent Particles. J. Roubaud-Valette. *Comptes Rendus,* 204. *pp.* 483–485, *Feb.* 15, 1937.—A photon is regarded as constituted by a particle obeying Dirac's equations for the electron and by an " anti-particle " obeying the complementary equations. It is then shown that the theory of the spins of these particles corresponds to the theory of the polarisation of the photon. G. C. McV.

2085. Photon Equations. J. Roubaud-Valette. *Comptes Rendus,* 204. *pp.* 747–749, *March* 8, 1937.—Using a system of complex numbers, operators are obtained corresponding to magnitudes having the symmetries of electric and magnetic fields regarded as representing photon fields, and from these are deduced equations identical with those found by de Broglie's treatment. It is shown that the equations for the photon can be obtained by consideration only of its mass and the potentials giving the associated electromagnetic field without any assumption on the charges and nature of its constituents. It can, consequently, be a neutrino and an anti-neutrino intimately united. N. M. B.

2086. Properties of the Electronic Photon. J. J. Placinteanu. *Comptes Rendus,* 204. *pp.* 485–487, *Feb.* 15, 1937.—The photon is regarded as being produced by the association of a positron and an electron. It is proved that a gas so constituted would have the correct statistics for photons, that the motion of the photon around its " centre of gravity " is zero and that a description of the emission of photons from excited atoms can be given. G. C. McV.

2087. Application of the Energy and Impulse Laws to the Collision of Particles with Radiation and with Pair Production. W. Braunbek. *Zeits. f. Physik,* 104. 9–10. *pp.* 619–637, 1937.—The laws of conservation of energy and momentum are applied to the collision of a moving particle with a particle at rest for the cases, (1) in which collision produces a quantum of radiation and (2) in which a particle pair is formed. The calculation is applied only to the case in which the directions of motion of all participating particles, including radiation quantum, lie in a straight line. In case (1) the highest energy which can be imparted to the quantum of radiation is calculated. In case (2) are calculated the highest energy which the produced particle pair can assume and the least rest-mass which the struck particle or the least energy which the striking particle must have in order that a pair of particles may be produced. The behaviours are geometrically illustrated in a three-dimensional energy space. It is shown that case (1) formula can be obtained from case (2) formulæ by a limiting transition to zero rest-mass of the particle pair. By means of a limiting transition to zero rest-mass of the colliding particle the case of pair formation from radiation is brought within the scope of calculation. J. E. K.

See also Abstracts 2021, 2056.

REFLECTION, REFRACTION AND DISPERSION.

2088. Optical Properties of Very Thin Metallic Films. P. Rouard. *Ann. de Physique,* 7. *pp.* 291–384, *March,* 1937.—Films of Au,

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Ag and occasionally Pt, prepared by kathodic sputtering in anthracene vapour on to glass and mica supports were examined for thicknesses 0–40$m\mu$. It was found that, over the range for which the optical methods of determining thickness were sound, an improved weighing method gave concordant results and, moreover, gave reasonable values for very thin films ($< 5m\mu$). The reflecting powers of the metal surface in contact with air and the transparent support were determined, and it is shown that the reflecting power of both Au/glass and Ag/glass surfaces passes through a pronounced minimum as the metal thickness increases from 0–10$m\mu$. This minimum occurs at different film-thicknesses for different wave-lengths and therefore a beam of white light which has undergone reflection at normal incidence at the glass/metal surface appears coloured according to the thickness of the metal film. The relationship between these colours and the corresponding film-thicknesses is given for Au and Ag. The phase-change occurring on normal reflection at the transparent-support/metal interface was found to be at first a retardation which, having passed through a maximum for each wave-length, gradually changes, with increasing film thickness, to an advance of value varying with film thickness. In the case of the longer wave-lengths ($>$ 5,500 Å) a jump of 2π from retard to advance occurs at the point where interference phenomena disappear. These results enable the conflicting experiments of earlier workers to be explained. The phase change at the air/metal surface is initially an advance which changes with increasing film thickness to a retardation reaching a maximum at 7 $m\mu$ for Au and 9 $m\mu$ for Ag. The observed reflecting powers were used to calculate the optical constants of the films, and the theoretical phase changes which should occur at surfaces having these constants were found to agree well with the experimental values. It is concluded that the classical theory of metals satisfactorily explains the observed phenomena if it be assumed that the optical constants of thin Au and Ag films differ from those of the massive metals.

A. G. Q.

2089. Hamilton's Characteristic Function and Bruns' Eiconal. M. Herzberger. *J.O.S.A.* 27. *pp.* 133–137, *March*, 1937.—Replying to the article by Synge [see Abstract 1202 (1937)] the author maintains that there is an essential difference between the characteristic functions of Hamilton and the three corresponding eiconals of Bruns; it is also maintained that the change by Bruns from the function of six variables to that of four variables was of major importance, without which much later development would have been impossible. **J. L. Synge** replies (*ibid. pp.* 138–144) at length and concludes that there is nothing which can be done by Bruns' method which cannot be done as easily (and sometimes more easily and more generally) by the method of Hamilton. A. H.

2090. Refractive Indices of ND_3 and DCl. O. E. Frivold, O. Hassel, and S. Rustad. *Phys. Zeits.* 38. *pp.* 191–195, *March* 15, 1937. Refractive indices of NH_3 and ND_3, and of HCl and DCl, are measured interferometrically at a number of visual wave-lengths. C. B. A.

2091. Refractometric Investigation of a Compound in Aqueous Solutions of $MgCl_2 + CaCl_2$. G. Spacu and E. Popper. *Zeits. f. phys. Chem.* 35. *Abt. B.* 2–3. *pp.* 223–235, 1937.—Measurements at several temperatures of the refractivity of aqueous solutions containing varying proportions of Mg Cl_2 and Ca Cl_2 show the existence of a compound when the solution contains equimolecular amounts of $CaCl_2$ and $MgCl_2$. [See also Abstract 4992 (1935)]. J. I.

***2092. Fluorescent Light Microscopy. E. A. Hauser and C. J. Frosch.** *J.O.S.A.* 27. *pp.* 110–111, *March*, 1937.—Discusses the source characteristics necessary for this type of work and surveys the sources available. A. H.

See also Abstracts 1967, 1971, 1972, 2065, 2143, 2144, 2277.

SPECTROSCOPY.

2093. Light Excitation by Collisions of Lithium Ions with Helium Atoms. W. Maurer. *Zeits. f. Physik*, 104. 9–10. *pp.* 658–665, 1937.—The first aim was the comparison of the He I and the Li II spectra. The results of Beeck, that the output in ionising collisions in rare gases becomes considerable when the alkali ion and rare gas have the same number of outer electrons, led to the expectation that Li^+ should be the better partner for He I excitation than Cs^+. The confirmation of this was the second aim. The source of ions and the arrangment have already been described [see Abstract 4699 (1936)]. Besides He I and the weak He II (4686) and Li II (5485), Si I lines were very strongly emitted. The intensity distribution in the Li I lines and He I is the usual one. The Li I lines are attributed to discharge of Li^+ by the collision with simultaneous excitation. The spin conservation rule was expected to apply, *i.e.*, triplet excitation of the atoms should be accompanied by triplet excitation of Li^+. This expectation is only partly fulfilled. J. E.

2094. Structure of the Spectra of SbVI and TeVII. L. Bloch and E. Bloch. *Comptes Rendus*, 204. *pp.* 424–426, *Feb.* 8, 1937.—The fundamental lines of TeVII are given as $^1S_0 - {}^3P_1 = 237\cdot54$ Å, $^1S_0 - {}^1P_1 = 232\cdot37$ Å and $^1S_0 - {}^3D_1 = 227\cdot84$ Å, the corresponding lines for SbVI being 292·33, 284·90 and 279·77 Å. The separations of these lines do not agree with those already assigned by Schoepfle. Lists of lines which have been analysed are given. F. S.

2095. New Method of Analysis of the Structure of Hα and Dα. W. V. Houston. *Phys. Rev.* 51. *pp.* 446–449, *March* 15, 1937.—The interferometer pattern due to a group of spectral lines can be expressed as a Fourier series, and the coefficients of this series can be regarded as the quantities to be measured. These coefficients can also be computed in terms of the positions, intensities, and the parameters describing the shapes of the lines. Although the equations cannot be explicitly solved for the latter quantitites in terms of the Fourier coefficients, numerical means can be used to find the parameters which best reproduce the observed values. This method has been applied to two plates of Hα and Dα. The results indicate that to fit the observations with the four strongest lines given by the theory it is necessary to make the separations of the two most intense components some 2 % less than the theoretical value. AUTHOR.

2096. Broadening of the Hg Green Line in High Pressure Arcs. L. Grillet. *Comptes Rendus*, 204. *pp.* 426–429, *Feb.* 8, 1937.—The line as given by the Gallois R.B.I. and Philips Philora H. P. 300 lamps, has been examined with a spectrophotometer of 22 Å per mm. dispersion and also with a plane grating of 0·41 Å per mm. In the Philora lamp the line is about 60 Å wide while the centre of gravity is moved about 4·5 Å towards the red. The R.B.I. lamp gives a slightly reversed line, 0·6 Å wide, moved about 0·64 Å to the red. The R.B.I. lamp is about 1·5 times as bright as the Philora. F. S.

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2097. Displacement of Principal Series Lines of Rubidium by the Addition of Rare Gases. Ny Tsi-Zé and Ch'en Shang-Yi. *Phys. Rev.* 51. *pp.* 567–571, *April* 1, 1937.—The positions of the principal series lines of Rb displaced by spectroscopically pure He, Ne and A are measured. The constant shift of the high terms reaches 37·24 cm^{-1} towards violet under 12·75 atmos. (at 570° K) for He; 2·08 cm^{-1} towards violet under 13·59 atmos. (at 590° K) for Ne; and 33·4^{-1} cm towards red under 7·12 atmos. (at 563° K) for A. The effective cross-sections for all the atoms at 1 $cm.^3$ at 1 mm. pressure calculated by Fermi's equation is 15·47 $cm.^2/cm.^3$ for He, 0·24 $cm.^2/cm.^3$ for Ne, and 23·7 $cm.^2/cm.^3$ for A in good agreement with the results of Füchtbauer from his experiment with Na and K, and of Wahlin by direct electrical method. In the range of rare gas pressures above relative density 5 the mean shifts of the high members of the Rb principal series increases more rapidly than linearly with density. AUTHORS.

2098. Temperature Shift of the Potassium Resonance Lines. G. F. Hull, Jr. *Phys. Rev.* 51. *pp.* 572–574, *April* 1, 1937.—Effect of temperature on the shift and half-width of the K resonance lines in absorption perturbed by N_2 pressures from 1 to 15 atmos. has been investigated. Two sets of data, one at 270° C and the other at 90° C, show that both shift and half-width vary with temperature in the same manner. As the "relative density" of N_2 is increased, the effect of temperature decreases, and becomes unobservable above relative density 7. The results are in agreement with Margenau's theory which predicts the presence of both the Lorentz type of broadening dependent on temperature and "statistical" broadening independent of temperature for low relative densities. The temperature effect decreases with increasing relative density, because of statistical broadening. AUTHOR.

2099. Sign of the Magnetic Moment of the K^{39} Nucleus. H. C. Torrey. *Phys. Rev.* 51. *pp.* 501–508, *March* 15, 1937.—The assignment of quantum numbers to the magnetic levels of alkali atoms depends on the sign of the nuclear magnetic moment. If a beam of normal alkali atoms is split in a weak inhomogeneous magnetic field and transitions are then induced among the component magnetic levels, a subsequent strong field analysis of a selected state suffices to identify its quantum numbers and hence to determine the sign of the moment. This method applied to K^{39} determines its nuclear magnetic moment to be positive in contradiction to the findings of Jackson and Kuhn from hyperfine structure data. A similar experiment on Na^{23} shows its nuclear moment to be positive in agreement with the hyperfine structure of Granath and van Atta. AUTHOR.

2100. Forbidden Spectral Lines. H. Niewodniczański. *Acta Physica Polonica,* 5. *pp.* 111–122; *Disc.,* 122–125, 1936. *In German.*—This is a resumé of work on the subject which has appeared since the article by Rubinowicz and Blaton [see Abstract 1089 (1933)]. In the first section the rules, according to which these lines should not appear, are explained. The second deals with present knowledge concerning electric quadripole lines and magnetic dipole lines, while the third is concerned with forbidden lines in the spectra of HgI and CdI. F. S.

2101. Theory of Fine Structure of Helium. G. Araki. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 128–155, *Feb.,* 1937. *In English.*—The general formula representing the singlet and the triplet system of He is calculated using Breit's Hamiltonian. The interaction between the singlet and the triplet system, and the polarisation effect of the outer electron on the inner electron are taken into account. The numerical separations of the triplet terms 1*s*2*p* ^3P, 1*s*3*p* ^3P, 1*s*3*d* ^3D and 1*s*4*d* ^3D are computed. The result is in good agreement with experiments.

AUTHOR.

2102. Spin-Orbit Interactions. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 161–165, *Feb.*, 1937. *In English.*—If the methods of finding energies of an atom or ion from considerations of electrostatic interactions are extended to heavier elements, the spin-orbit interactions, which are magnetic in nature, become significant for the separation of terms. But if these separations are not large compared to those due to electrostatic interactions the approximate position of the centres of the multiplets can be determined by considering the second order perturbations, or, if few adjacent terms have particularly small separations, by solving the secular equation for that part only. The operations are carried out and the accuracy of the results is examined.

N. M. B.

2103. Energy of the Configuration d^{9}p in Intermediate Coupling. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 166–171, *Feb.*, 1937. *In English.*—A simplified method is given for estimating the parameter values contained in the coefficients of the higher degree secular equations whose roots give the energy levels of many electron configurations in intermediate coupling. Results are tabulated in detail and examined.

N. M. B.

2104. Emission Spectra of Metallic Salts. P. Mesnage. *Comptes Rendus*, 204. *pp.* 761–763, *March* 8, 1937.—The emission spectra of $MnCl_2$, $FeBr_2$ and FeI_2 excited by the h.f. discharge, in the region 2300–6700 Å, are generally described. $MnCl_2$ shows six groups of bands in the region 3500–3900 Å, of similar structure to that previously reported for $FeCl_2$; there are also bands in the region 4300–4600 Å and in the neighbourhood of 5000 Å. In $FeBr_2$ there are a few u.v. bands but no system comparable with that found for $FeCl_2$ and $MnCl_2$, but there are intense irregular bands in the red. FeI_2 shows no band spectrum at all.

D. H. F.

2105. Band Spectra of SbF and BiF. G. D. Rochester. *Phys. Rev.* 51. *pp.* 486–490, *March* 15, 1937.—New band spectra attributed to the molecules SbF and BiF have been excited by active nitrogen. The spectrum of SbF from 2000–5500 Å is found to have three groups of bands lying in the regions 3600–5200, 2600–2700 and 2200–2430 Å. Analysis of the first group shows that 61 bands out of 69 can be placed into two systems with the following vibrational constants, in cm^{-1} :—

System	ν_e	ω_e'	$x_e'\omega_e'$	ω_e''	$x_e''\omega_e''$
A_1	21887·5	411·3	1·71	616·9	2·89
A_2	23992·5	420·0	1·75	612·6	2·58

The second group consists of a few isolated bands degraded to shorter wave-lengths and the third of bands in closely spaced sequences and also degraded to shorter wave-lengths. A preliminary analysis indicates that the bands in the latter group can be placed into two systems for which $\omega_e' \sim 700$ cm^{-1}, $\omega_e'' \sim 620$ cm^{-1} and $\Delta\nu_{21} \sim 1850$ cm^{-1}. Three new systems of bands, degraded to shorter wave-lengths and forming a triplet system with wide multiplet separations, (7330 cm^{-1} and 4800 cm^{-1}), are found in the spectrum of BiF at 3050–3250, 2650–2850 and 2250–2350 Å. Photographs taken with small dispersion indicate that $\omega_e' \sim 620$ cm^{-1} and $\omega_e'' \sim 520$ cm^{-1}.

AUTHOR.

2106. Band Spectra of Ionised Hydrogen Halides. Part II. HCl and DCl Spectra. F. Norling. *Zeits. f. Physik,* 104. 9–10. *pp.* 638–652, 1937.—U.v. bands of HCl and DCl are photographed with dispersion of 0·95 Å per mm. and analysed. The spectra are excited in a special hollow kathode tube described in Part I of this investigation [see Abstract 3501 (1935)] and further improved mainly by decrease of the kathode aperture. The discharge conditions are briefly discussed. The analysis of 10 HCl^+ bands and 5 DCl^+ bands is presented in tabular form. In the case of HCl^+ the measurements and analysis agree with the previous results of Kulp [see Abstract 1220 (1931)]. The bands of DCl^+ which have not been previously described are the 0–0, 0–1 and 1–0, $^2\Sigma - {}^2\Pi_{3/2}$ and the 0–0 and 0–1, $^2\Sigma - {}^2\Pi_{1/2}$ bands. Accurate values of the molecular constants of HCl^+_{35} and DCl^+_{35} are deduced and tabulated. The result of calculations of the isotope effects and fine structures will form the subject of a subsequent paper. J. E. K.

2107. Infra-Red Absorption of Dilute Solutions of HCl and HBr. C. E. Leberknight and J. A. Ord. *Phys. Rev.* 51. *pp.* 430–433, *March* 15, 1937.—The infra-red spectra of dilute solutions of HCl and HBr in benzene, C_6H_5Cl, CCl_4, and $SnCl_4$ were obtained on a prism grating spectroscope of resolving power 15,000 in the 1st order. Extinction curves are given. The solutions can be treated as dilute gases composed of damped simple harmonic oscillators. The ratio, change of force constant of HCl/change of force constant of HBr, for the solutions is about 1·32, which is the ratio of their dipole moments in the vapour state. Values of the Einstein coefficient of absorption and of ϵ in the equation $\mu = \mu_0 + \epsilon(r - r_0)$ for the electric moments of the molecules are calculated. H. G. C.

2108. Effects of Certain Liquids on the OH Vibrational Band of Alcohol. W. Gordy. *Phys. Rev.* 51. *pp.* 564–566, *April* 1, 1937.—Transmission curves for several different concentrations of methyl alcohol in dioxane, methyl cyanide, isopropyl ether, benzene and carbon tetrachloride, and of ethyl alcohol in dioxane were obtained in the region $2·55\mu$ to $3·15\mu$. Dioxane, methyl cyanide, and isopropyl ether were found to shift the OH vibrational alcohol band to the shorter wave-lengths and to increase its intensity appreciably. There appeared to be no definite relationship between these changes and the electric moment of the solvent molecule. It is suggested that these variations indicate some type of interaction of the solvent molecule with the OH group. It may be possible to interpret the results as indicating a linkage of the solvent molecules with those of the alcohol through the formation of H bonds. AUTHOR.

2109. Infra-Red Absorption Spectra of Certain Liquid Mixtures. W. Gordy. *Am. Chem. Soc., J.* 59. *pp.* 464–466, *March,* 1937.—In mixtures of aniline with acetone, ethyl acetate, ethyl formate, methyl cyanide and isopropyl ether, the NH vibrational band of aniline is shifted to shorter wave-lengths and its intensity is increased. In mixtures of aniline with CCl_4 this band appears to remain constant. Other aniline bands remain approximately constant for all the mixtures. The CO band of acetone, ethyl acetate and ethyl formate is shifted to longer wave-lengths, and its intensity increased in mixtures of these liquids with aniline. It is suggested that the observed changes in the spectrum indicate association of the liquids through dipole interaction. The formation of H-bonds is proposed as a possible interpretation of the results. AUTHOR.

2110. Infra-Red Absorption of Liquid and Gaseous 1, 4-Dioxane. D. S. McKinney, C. E. Leberknight and J. C. Warner. *Am. Chem. Soc., J.* 59. *pp.* 481–484, *March*, 1937.—The infra-red absorption of liquid and gaseous 1, 4-dioxane is investigated between 1·4 and 14·0 μ using a rock-salt spectrometer of unusually high resolving power. The region from 2·27 to 3·72 μ is also investigated using a prism-grating spectrometer. The absorption in the gas is not much different from that observed in the liquid. In passing from the liquid to the gas there is a slight shift to higher frequencies: For example, the liquid bands in the 3·45 μ region are shifted 4 to 9 wave numbers, and the vapour band shape is characteristic of the envelope of vibration-rotation lines.

2111. Velocity of Exchange of Protons and Deuterons between Water Molecules. K. Wirtz. *Zeits. f. Physik,* 104. 7–8. *pp.* 613–618, 1937.—Unsuccessful attempts are made to determine the velocity of the exchange reaction $H_2O + D_2O = 2HDO$ by automatic registration of the infra-red absorption characteristic of the HDO molecule. For practical reasons it is not possible to commence the observations less than 20 sec. after the beginning of the reaction and it is found that within this time the reaction proceeds to completion. It is pointed out that the upper limit for the time of reaction, as deduced from the theories of Hückel and of Bernal and Fowler concerning the abnormal mobilities of H^+ and OH^-, is only about 0·01 sec. L. A. W.

2112. Induced Predissociation in the Visible Bromine Spectrum. L. Avramenko and V. Kondratjew. *Phys. Zeits. d. Sowjetunion.* 10. 6. *pp.* 741–750, 1936. *In German.*—Experiments are made upon the predissociation induced in the visible absorption spectrum of Br_2 vapour. Four maxima of selective enhancement of absorption, corresponding to $v' = 23, 26, 30$ and 34, are observed and are interpreted as regions of induced transition of the excited Br_2 molecule to unstable electronic states. It is further observed that the plot of the reciprocal of the alteration of the absorption coefficient against the reciprocal of the pressure of the foreign gas is a straight line for pressures up to 500 mm. The effective cross-section for the collisions, as deduced from these data, comes out to be about 10 times greater than the gas-kinetic cross-section. The observed effects are practically independent of that nature of the foreign gas, whence it is concluded that chemical forces play a small part in the mechanism.

L. A. W.

2113. Induced Predissociation of S_2, Se_2, and Te_2. B. Rosen. *Acta Physica Polonica,* 5. *pp.* 193–205, 1936. *In French.*—In certain cases the selection rules for the radiationless transition involved in predissociation may be suppressed by the action of collision or a magnetic field and an induced predissociation produced. Three cases are considered in reference to published work, and the results considered in reference to the predissociation of S_2, Se_2, and Te_2. The mode suggested for the predissociation differs from that previously accepted. H. G. C.

2114. Absorption Spectra of Alkali Halide Crystals. R. W. Pohl. *Acta Physica Polonica,* 5. *pp.* 349–356; *Disc.,* 356–360, 1936. *In German.*—The absorption spectra of the alkali halide crystals are affected considerably by changes in constitution of the crystal lattice. The changes in the spectra including the appearance of new bands which result from increasing the relative amounts of alkali metal or halogen in the crystal are described. Increase in the relative alkali metal content is produced by causing electrons to diffuse into the crystals. The excess alkali atoms appear in three kinds of binding within the crystal termed F-centres (colour centres), U-centres and F-centres each producing characteristic absorption bands. The type of binding can be changed by photochemical or thermal action, the changes from the F to F^1 are accompanied by electronic currents of measurable magnitude. Simultaneous current and optical measurement promises to throw much light on the mechanism of electron conduction of photochemical change in alkali salts. J. E. K.

2115. Absorption Curves of Unsaturated Hydantoins. Margaret K. Seikel. *Am. Chem. Soc., J.* 59. *pp.* 436–439, *March,* 1937.—The absorption curves together with other physical and chemical properties of anisalhydantoin and its N-3 substitution products as compared with N-1- or N-1-N-3- derivatives, serve to differentiate these substances into two separate and distinct groups. The suggestion is made that the differences between these groups may be due to corresponding differences in configuration. AUTHOR.

2116. Pressure Effect in the Spectra of the Hydrides. E. Olsson. *Zeits. f. Physik,* 104. 5–6. *pp.* 402–406, 1937.—The phenomenon designated as pressure effect in the AlH spectrum is (in agreement with Farkas) established as connected chiefly with the transition from electronic excitation to thermal radiation. The fundamental difference between the emission of the " flame " and that of the aureole is experimentally noted. The thermal emission of CaH is connected with the absorption spectrum; not however the arc discharge at low pressures. J. J. S.

2117. Substitution and Absorption Band Displacement. G. Förster and J. Wagner. *Zeits. f. phys. chem.* 35. *Abt. B.* 5. *pp.* 343–353, 1937.—A continuation of previous work [see Abstract 4209 (1936)]. The absorption spectra of 7 halogen derivatives of aniline and of 7 halogen derivatives of nitrobenol are communicated and the position, intensity and structure of the bands discussed. It is found that the rule of Conrad-Billroth previously given applies only to Cl- and Br-substitutions in aniline. F. S.

2118. Electron-Band Spectrum of $HgCl_2$ in the Schumann Region. M. Wehrli. *Helv. Phys. Acta,* 10. 2. *pp.* 163–164, 1937. *In German.*—The absorption has been studied in a 4 cm. tube at 0·002 mm. pressure. The bands are degraded towards the red and lie between 1730·7 and 1670·5 Å. The fundamental frequencies deduced are compared with those given by Braune, Engelbrecht and Knoke. F. S.

2119. Spectra of Neutral and Ionised Boron Hydride. G. M. Almy and R. B. Horsfall, Jr. *Phys. Rev.* 51. *pp.* 491–500, *March* 15, 1937.—The spectrum of boron hydride, as excited in the kathode of a Schüler lamp, consists of at least three systems, $^1\Pi \rightarrow {}^1\Sigma$ of BH, $^3\Sigma \rightarrow {}^3\Pi$ of BH, and a new system, $^2\Pi \rightarrow {}^2\Sigma$, due to BH^+. BH, $^1\Pi \rightarrow {}^1\Sigma$.—This system has been extended to include the (2,2) band. One is thereby enabled to refine the rotational and vibrational constants of the system and, from a study of dissociation by rotation, to fix the heat of dissociation (D_e) of the normal state at 3·60 ± 0·05 eV. BH, $^3\Sigma \rightarrow {}^3\Pi$, (0,0) head at λ3694.—The fine multiplet structure of this system has been resolved and the transition, previously reported to be $^3\Pi \rightarrow {}^3\Sigma$, established as $^3\Sigma \rightarrow {}^3\Pi$. The $^3\Pi$ state is regular and near case *b* ($A/B = +0{\cdot}47$). BH^+, $^2\Pi \rightarrow {}^2\Sigma$, (0,0) head at λ3766.—This system is the analogue of the green bands of the isoelectronic molecule BeH. Application of the Hill and van Vleck theory to the $^2\Pi$ state does not yield an A/B which is constant with increasing J. Refinement of the theory to include the rotational D term along the lines suggested by Gilbert for $^2\Pi$ states, does not greatly improve the situation. The remaining discrepancy is probably due to unobservable $^2\Sigma$ doubling. The Λ type doubling has been evaluated and compared with theory with results very like those in BeH. AUTHORS.

2120. Calculation of Terms of the Hydrogen Molecule Ion. E. Hellmig. *Zeits. f. Physik*, 104. 9–10. *pp.* 694–710, 1937.—A number of excited terms are calculated in the approximation of geometrical optics for different values of the internuclear distance. R. P.

2121. Band Spectroscopic Basis of the Limiting Curve of Dissociation. R. Schmid and L. Gerö. *Zeits. f. Physik*, 104. 11–12. *pp.* 724–734, 1937.—In connection with consideration of the predissociation limit of the CO-spectrum at 11·06 volts, which also represents the dissociation limit of the $a^1\,{}^3\Sigma^+$ state, it is shown that the case of dissociation by rotation leads quite generally to a limiting curve of dissociation which represents the energy values of the maxima of the effective potential curves as a function of $J(J+1)$. The curve connecting the energy values of vibrationless molecules with $J(J+1)$, *i.e.* the curve of minima of the effective potential curves, can also be plotted in the same coordinate system. The tangents to both curves permit a simple determination of nuclear distances and potential values. From purely empirical data of band analysis and observation of the breaking off of rotation term sequences the potential function can be determined. This method is illustrated by the $^2\Sigma$ ground state of HgH. The method of limiting curves can be applied in a simple manner to throw light on the crossing of potential curves and the question of the kinetic energy of separated atoms after dissociation. J. E. K.

2122. Deformation Oscillations of C_2H_2 Molecule. W. H. J. Childs and H. A. Jahn. *Zeits. f. Physik*, 104. 11–12. *pp.* 804–806, 1937.—It is pointed out that in the treatment by Necke and Ziegler [see Abstract 4213 (1936)] of the oscillation spectrum of C_2H_2 an important factor has been overlooked, and revised formulae are deduced. But it is emphasised that the general principle on which that treatment is based is not criticised. D. H. F.

2123. Low Electronic States of Simple Heteropolar Diatomic Molecules. Part III. Hydrogen and Univalent Metal Halides. R. S. Mulliken. *Phys. Rev.* 51. *pp.* 310–332, *March* 1, 1937.—Electronic structures for states involved in near u.v. spectra of AX are discussed, and tentative potential energy curves for some of the states of HI, AgI and NaI are drawn. It is concluded that observed HX continuous absorption involves three Q levels $^3\Pi_1$, $^3\Pi_0^+$ and $^1\Pi$, but with Ω-s coupling, and that the observed absorption goes mainly to the $^3\Pi_1$, and $^1\Pi$ levels (in contrast to what is found in halogen spectra). Similarly for AgX it is concluded that transitions to the three levels gives continuous absorption, whilst the various band systems of CuX and AuX at long wavelengths are ascribed to electron levels derived mainly from metal atoms in which a *d* electron has been excited. For MX it is concluded that the process of light absorption in the near u.v. has approximately the effect of transferring an electron from X^- of M^+X^- to the M atom, leaving two neutral atoms M and X which tend to fall apart. The lack of valence attraction between neutral M and X thus indicated probably involves a failure in MX of the additivity rule for homopolar bond energies. Possible reasons for this probable failure (highly unequal size and energy of valence orbitals of M and X) are discussed. Franck's empirical spectroscopic

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criterion for distinguishing between atom-molecules and ion-molecules is also discussed. From the present analysis of the electronic states involved in the spectra of HX, AgX, and MX, and from previous work on X_2 and XY, it is concluded that for molecules containing halogen atoms the criterion does not have a theoretical basis but, insofar as it is valid depends on the occurrence of certain rather special and fortuitous circumstances. (X, Y = halogen, A = H or univalent metal, M = alkali metal). [For Part II see Abstract 246 (1937).] A. H.

2124. Relativistic Wave Functions in the Continuous Spectrum for the Coulomb Field. M. E. Rose. *Phys. Rev.* 51. *pp.* 484–485, *March* 15, 1937.—For purposes of reference the continuous spectrum solutions of the Dirac wave equation for the Coulomb field are given. The solutions in the form of series and integral representations and the asymptotic behaviour at large distances are included among the formulae. AUTHOR.

2125. Continuous Fluorescence and Absorption Spectra. W. Finkelnburg. *Acta Physica Polonica,* 5. *pp.* 1–14; *Disc.*, 14–20, 1936. *In German.*—A discussion of the ways in which continuous fluorescence can theoretically arise, and of the methods by which it can be investigated. A. C. M.

2126. Resonance Spectra of Diatomic Molecules. P. Swings. *Acta Physica Polonica,* 5. *pp.* 215–225; *Disc.*, 225–228, 1936. *In French.*—A discussion of recent results of the study of resonance series. A summary is given of the methods of investigation and some outstanding examples (the auto-resonance of I_2, the resonance of HD in an A tube, etc.) described. A survey of those molecules investigated in each column of the periodic table is given. H. G. C.

2127. Quantum Interpretation of the Mirror Symmetry of Absorption and Luminescence Spectra. W. Lewschin. *Acta Physicochimica,* 6. 2. *pp.* 213–228, 1937. *In English.*—An outline is given of the process of fluorescence of complex molecules which are treated as anharmonic oscillators. The theory is based on five assumptions. The most essential and specific condition for the molecules exhibiting the spectrum symmetry is the condition which requires complete similarity of the upper and lower systems of the energy levels of a molecule. Moreover, the theory utilises the conclusion, derived from experiments, regarding the equal probability of transitions between any vibration levels of two systems of levels corresponding to one electronic transition. AUTHOR.

2128. Molecular Symmetry of Thiophene. G. B. Bonino. *Accad. Lincei, Atti.* 24. *pp.* 374–380, *Nov.* 15, 1936.—The author in a previous paper having discussed the molecular symmetry of thiophene [see Abstract 1691 (1937)] in relation to its Raman and infra-red spectra, attributing to the molecule itself the symmetry C_{2v}, proceeds in the present paper to consider other hypotheses relative to the symmetry of this molecule. The following two models are first considered: (1) pentagonal model (with or without double bonds) with a non-plane molecule (*e.g.* with the hydrogens not lying in the plane of the heterocyclic ring; (2) pyramidal model with square base with four C–H in the same plane at the corners of the base and a "tetravalent" sulphur at the vertex of the pyramid. A third model is than considered, (3) a square plane model deduced from (2) projecting the other atom at the centre of the square base. For thiophene the greater number of the Raman and infra-red lines are favourable for a symmetry C_{2v}. For a complete discussion not yet carried out there are helpful analogies with similar compounds.

J. J. S.

2129. Intensity of the Raman Effect in Binary Mixtures. F. Cennamo and E. Vitale. *N. Cimento*, 13. *pp.* 465–468, *Dec.*, 1936.—Association in binary mixtures of ethyl alcohol and benzene was sought for by measuring the intensities of five of the main Raman lines of the benzene ring and of three characteristic Raman lines of alcohol in binary mixtures of different proportions. All the benzene lines and two of the alcohol lines show a maximum deviation from proportionality between line intensity and concentration for a mixture containing approximately two molecules of benzene to one of alcohol. Thus association is indicated and for a mixture in the proportions found by other methods. W. S. S.

2130. Raman Spectrum of SO_3. H. Gerding, W. J. Nijveld and G. J. Muller. *Zeits. f. phys. Chem.* 35. *Abt. B.* 2–3, *pp.* 193–215, 1937.—The Raman spectra are recorded with high dispersion for the following:—(*a*) liquid SO_3 at 16°, 30°, 53°, and 70° C.; (*b*) liquid mixtures of SO_3 and SO_2, containing 75, 50, and 25 % (molecular) of SO_3, at about 50° C.; (*c*) gaseous SO_3 at a pressure of about 11 atmos. The results were:—(*a*) 22 lines were found at 16°, and of these 531, 1068 and a broad double-band at 1389 increased greatly in intensity with temperature-rise. There was no shift of lines as the temperature changed; (*b*) no compound appeared to be formed. As the SO_3 was progressively diluted, 531, 1068 and 1389 noticeably strengthened, while the other lines faded away; (*c*) only one line at 1069 cm^{-1} appeared. Conclusions: 531, 1068 and 1389 belong to the molecule $(SO_3)_1$ in the liquid state. The other lines belong to $(SO_3)_m$, where *m* exceeds 1 and is probably 3. $(SO_3)_1$ has a plane structure like the NO_3' and CO_3'' ions. A spatial structure is suggested for the molecule S_3O_9 [see following Abstract]. A. C. M.

2131. Raman Spectra of γ- and β- forms of SO_3. H. Gerding and N. F. Moerman. *Zeits. f. phys. Chem.* 35. *Abt. B.* 2–3. *pp.* 216–222, 1937.—Raman spectra are reported (*a*) for the ice-like γ-modification of SO_3 (m. pt. 16·8° C.) and (*b*) for the low-melting point asbestos-like β modification (m.pt. 31·5° C.). Conclusions:—(*a*) the molecule is polymerised to the form S_3O_9, which may contain a hexagonal ring of alternate S and O atoms. There are probably single molecules also present in small concentration. This modification behaves as a "complex" as envisaged in Smit's theory of complexity; (*b*) this modification has probably a chain form [see preceeding Abstract]. A. C. M.

2132. Raman Spectra of Aromatic Hydrocarbons with Condensed Nuclei. Part I. Anthracene and Phenanthrene. R. M. Ansidei. *Accad. Lincei, Atti*, 24. *pp.* 368–373, *Nov.* 15, 1936.—The Raman spectra of these hydrocarbons, hitherto lacking, are difficult to obtain considering the intense fluorescence and the relatively strong background. But acquaintance with them was necessary in order to obtain a knowledge of the symmetry of the molecules of the aromatic bodies. Discrete spectra (although incomplete) were got by distilling *in vacuo* the products, already chemically very pure, and obtaining the spectra in solution in different solvents with the addition of a small trace of nitrobenzene. In comparison spectra were registered the lines given by the solvent with the trace of nitrobenzene, working under conditions identical with those employed in dealing with the substance under examination. Investigation showed: (1) The poverty of Raman lines in the spectrum of anthracene

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compared with that of phenanthrene, analogous to the poverty of maxima of infra-red absorption of the first with respect to the second ; (2) the non-correspondence between the Raman lines and the infra-red of anthracene as opposed to the good, if not general, correspondence between the infra-red spectra and the Raman spectra for phenanthrene. Utilising a method of calculating rapidly with the aid of the theory of groups the types and number of the characteristic oscillations of a molecule, the author has applied the method, due to Wigner, Jirga and Bonino, to the case of the molecules of anthracene and phenanthrene. Tables indicating the symmetry, number of oscillations, the Raman effect, and the infra-red absorption are given, as well as diagrams illustrating the symmetry and arrangement of the molecule. J. J. S.

2133. Raman Spectra of Polymorphic and Isomorphic Crystals. M. Vuks. *Acta Physicochimica,* 6. 1. *pp.* 11–24, 1937. *In German.*—The Raman spectra were investigated for ρ-dichlorobenzene at various temperatures, and a transition is found at 32° C., when the α-modification turns into the ρ-form. The Raman lines of the two modifications which differ widely from one another, are those near to the exciting lines, which allows their identification as lattice vibrations. As the temperature was lowered, the lattice frequencies of both modifications increased, and this is explained by considering the dependence of the volume and elastic constants of the crystals on the temperature. Comparison of the Raman spectra of ρ-dibromobenzene, ρ-bromochlorobenzene and both modifications of ρ-dichlorobenzene show that the first too must normally be isomorphic with the α-modification of ρ-dichlorobenzene. A reason is given for considering the $\alpha \rightarrow \beta$ transformation of the Cl compound to be due to a change in the orientation of the molecules in the lattice. The spectra of the liquid substances are also discussed. A. C. M.

2134. Raman Spectra of Crystal Powders. R. Ananthakrishnan. *Indian Acad. Soc., Proc.* 5*A. pp.* 175–184, *Feb.,* 1937.—The paper deals with the application of the Raman effect to the study of the exchange reaction between NH_4Cl and D_2O. The Raman spectra of the *d*-ammonium chlorides ND_4Cl, ND_3HCl and ND_2H_2Cl obtained by exchange reactions have been reported. The spectral data are complete in the case of ND_4Cl while they are incomplete in the case of the other two compounds. The Raman spectrum of ND_4Cl is compared with that of NH_4Cl and discussed in some detail. The spectrum of the water recovered from the exchange reaction has been photographed directly and also as water of crystallisation in strontium chloride. The results are compared with the Raman spectra H_2O and D_2O in the one case, and with the spectrum of $SrCl_2 \cdot 6H_2O$ in the other. There appears to exist differences in the structure of the water band in the Raman spectrum of the water of crystallisation of the salt when H_2O is replaced by D_2O. [See also Abstract 1701 (1937)].

***2135. Application of the Logarithmic Sector to Corrosion Problems. S. A. Burke.** *Faraday Soc., Trans.* 33. *pp.* 309–324, *Feb.,* 1937.—The technique of the logarithmic sector method is described, including a modification of the Hitchen sparking tube [see Abstract 447 (1932)]. The photographic aspect is considered in detail, including effects of intermittency and background. The accuracy is estimated as 7·8 %, although this figure may rise to 15 % if the non-linear portion of the calibration curve is used. The method is applied to corrosion problems by employing it to analyse corroding solutions for the metals which they dissolve. Within experimental error, the metals were found in the same proportions in solution as in the steels studied for corrosion. F. S.

***2136. Application of the Brunsviga Twin 13Z Calculating Machine to the Hartmann Formula for Spectrograms. L. J. Comrie.** *Observatory,* 60. *pp.* 70–73, *March,* 1937.—A mechanical method of computing wave-lengths from the Hartmann formula is developed. Full advantage is taken of the constancy of three of the elements in the formula, while all writing and mental work are eliminated. A convenient method of determining the three constants is also given ; in this also mental work is eliminated, two quantities only are written, and the constants (which need not be written) are produced in the positions they are to occupy on the machine when unknown wave-lengths are being determined from given measures. AUTHOR.

***2137. Direct-Reading Comparator for Spectra. L. G. Hoxton and D. W. Mann.** *J.O.S.A.* 27. *pp.* 150–154, *April,* 1937.—An instrument is described which, by the addition of two moving parts to the conventional form of comparator, enables the observer to read from the precision screw directly the values of the wave-lengths or wave numbers that would ordinarily be computed by the Hartmann forumla. The extra moving parts are (1) a light carriage on geometric ball-bearing ways to carry the plate and (2) a transfer mechanism functioning between that and the main carriage. The whole apparatus operates on a principle of geometric projection and is, in effect, a mechanical equivalent of the Hartmann formula. It is applicable to grating as well as prismatic spectra. AUTHORS.

2138. Spectrochemical Studies of Coloured Derivatives of Quinoneimine. T. Uémura and M. Abé. *Chem. Soc. Japan, Bull.* 12. *pp.* 59–70, *Feb.,* 1937. *In French.*—15 derivatives of quinoneimine were prepared and their absorption spectra obtained by a continuous current metallic arc. The spectra of the monoimines are similar to that of *p*-quinone. The diimines in general have a stronger absorption with a maximum at frequency = 2050. The effect on the spectra of the substitution of various radicals is discussed. H. G. C.

2139. Spectrochemistry of Unsaturated Compounds. K. v. Auwers and R. Hügel. *Zeits. f. phys. Chem.* 178. *Abt. A.* 4. *pp.* 315–321, 1937.—The spectrochemical behaviour is investigated of a number of organic compounds which have several isolated conjugations, and it is shewn that the exaltation grows with the number of those conjugations, *i.e.,* there is a specific effect of the conjugations on the refraction and scattering-power. The substances investigated were a series of esters of glycol and of glycerin with saturated and unsaturated acids. A. C. M.

2140. Spectrochemistry of Pyridine and Pyridone Derivations. K. v. Auwers. *Zeits. f. phys. Chem.* 178. *Abt. A.* 4. *p.* 322, 1937.—A number of corrections to tables of figures given in a previous paper [see Abstract 2400 (1933)]. A. C. M.

2141. Spectrograph in the Iron Foundry. H. B. Vincent and R. A. Sawyer. *J. of Applied Physics,* 8. *pp.* 163–173, *March,* 1937.—A condensed spark is used as source and photographs taken with a Littrow spectrograph, 8 exposures being made on one plate. The spark is chosen to give reliability of results. The normal time of recording is one sample per min. while the time to produce a dry plate for examination on a microphotometer is less than 9 min. The range of analyses is : Cr 0·01 to 1·50 % ; Cu, 0·20 to 3·00 % ; Mn, 0·30 to 1·25 % ; Mo, 0·07 to 1·50% ;

Ni, 0·15 to 2·00% ; Si, 0·50 to 4·00 %. The method is shown to be more reliable than chemical wet methods, while the average accuracy of a single determination deviates from the actual amount present by not more than ± 1 % of the amount of element present. F. S.

See also Abstracts 1868, 1889, 2053, 2059, 2078, 2157, 2158.

VELOCITY OF LIGHT.

See Abstract 2083.

VISION.

2142. Photometric Discrimination with a Diffuse Boundary. W. E. K. Middleton. _J.O.S.A._ 27. _pp._ 112–116, _March_, 1937.—Measurements were made of the contrast threshold (Fechner fraction) in a bipartite photometric matching field in which the boundary between the two halves was either sharp or diffuse. In the latter case the transition of brightness could be made to correspond to that obtained at the boundary of a dark object viewed against the sky on a foggy day. The degree of diffuseness of the boundary could be specified by the angle in minutes subtended at the eye by the width of the band of varying brightness. The results showed that up to a transitional width of at least 5 min. there is little if any increase in the contrast threshold above the value for a sharp boundary. For transitional widths between 10 and 30 min. the contrast threshold was found to increase linearly with the width. The author concludes that it is unlikely that diffusion has any great effect on the visual range of objects in fog, at least by way of altering the contrast threshold. W. S. S.

2143. Coloration of Retinal Images and Chromatism in General. C. Lapicque. _Comptes Rendus_, 204. _pp._ 522–524 ,_Feb._ 15, 1937.—It has been shown previously that the retinal image of a point source of white light consists of a detached central part surrounded by a halo. The relative spectral energy distribution in the central spot is here calculated for different sizes of the entrance pupil. It is found that for pupils of more than 1 mm. dia. the derived energy distribution is such as might be expected to give a pronounced yellow coloration to the image. The author deduces that a weak source of white light such as a star should appear yellow according to this calculation. The fact that we see the star as white is attributed to an " internal functional reaction " of the visual apparatus which causes us to interpret a yellow spot surrounded by a blue halo as a white point. For a pupil of 1 mm. dia. the yellow coloration of the central spot is absent and for still smaller pupils the central spot becomes bluish. This behaviour results from the opposed effects of diffraction and chromatic aberration on the relative energy distribution. The notion of an achromatic aperture is extended to other optical systems uncorrected for chromatic aberration. W. S. S.

*2144. **Photoelectric Optics.** _Electrician_, 118. _p._ 295, _Feb._ 26, 1937.—A description is given of a new refractionometer invented by G. Collins by means of which the refraction of the eye can be measured using infra-red light which is invisible to the subject. An image of a lamp filament is formed on the fundus of the eye through an infra-red filter. An image of the fundus image is then formed on a grid placed over the aperture of a photoelectric cell which is sentisive to the infra-red. By means of a vibrating mirror the primary image is made to vibrate on the fundus so that the secondary image falls alternately on an opening and on a bar of the grating. Thus an alternating photoelectric current is produced which can be amplified. This result is only obtained, however, if the focusing of the images is correct, and the focusing depends on the refraction of the observed eye. Thus a means of determining the latter is obtained. W. S. S.

X-RAYS.

2145. X-Ray Absorption. H. Küstner and H. Trübestein. *Ann. d. Physik*, 28. 5. *pp.* 385–408, *March*, 1937.—A method of calculation is developed which permits of the calculation, from an observation of the mass absorption coefficient in the long, medium and short wave-length regions, of the course of the absorption curve for substances composed of atoms of low atomic weight. A quantitative analysis of the absorption into photo-absorption, absorption by scattering and scattered radiation can be made as well as a determination of the photo-absorption law $C \cdot \lambda^n$. The classical mass scattering coefficient can also be determined. Experimental work with monochromatic X-rays shows that the course of the absorption curve can be given entirely as a joint effect of pure photo-absorption and pure Compton scattering. No part due to classical scattering was found. The absorption coefficients of several atoms were determined as well as the absorption law for dry air. The agreement with other work was good. The ratio $F(\lambda)$ of ionisation in air to the energy of the incident X-rays was calculated. The function obtained was found to have a minimum at about 0·12 Å and a maximum at about 0·05 Å. G. O. B.

2146. Curved Rock-Salt Surfaces. D. B. Gogoberidse. *Phys. Zeits. d. Sowjetunion*, 10. 6. *pp.* 826–830, 1936. *In German.*—The work of Komar and Mochalov [see Abstract 3961 (1936)] on plastically deformed crystals is followed up in connection with the production of curved rock-salt surfaces which focus an X-ray beam. The author concludes that the surface is split up into a series of small blocks which follow the lines of force. The total effect is to form a mirror which acts as a reflector for the X-rays. J. I.

2147. Search for Element 87. F. R. Hirsh, Jr. *Phys. Rev.* 51. *pp.* 584–586, *April* 1, 1937.—Using $CsHSO_4$ prepared from lepidolite and concentrated for element 87, X-ray examination at first showed a line thought to indicate this element. Further examination, however, shows this to be due to imperfection in the calcite crystal used. Reasons are given for thinking that the lines thought by Hulubei [see Abstract 3722 (1936)] to indicate element 87 are really due to Hg. The existence of this element is therefore still not proved. C. A. S.

2148. Relative Probability of Excitation of the Three L-Levels of Tungsten as a Function of the Velocity of the Kathode Rays. W. J. Huizinga. *Physica*, 4. *pp.* 317–324, *April*, 1937. *In English.*—It has been shown that for tensions more than twice the critical tension the probability of excitation of the L_I-levels increases relatively to that of the L_{II}- and L_{III}-levels when the velocity of the exciting kathode rays increases. In the case of W this increase is about 20 % when the tension increases from 25 to 40 kV. AUTHOR.

2149. Determination of h/e from the X-Ray Spectrum. J. DuMond and V. Bollman. *Phys. Rev.* 51. *pp.* 400–429, *March* 15, 1937.—Two accurate determinations of the short wave-length limits of the continuous X-ray spectrum have been made, one at about 10,000 V and one at about 20,000 V, by the method of isochromats under very steady

V.4
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applied voltage. The two crystal spectrometer was used along with the Kβ_2 line of Mo and the Lβ_1 line of W. A full description is given of the experimental technique, and the necessary corrections and precautions, including especially the effect of the finite resolution of the spectrometer. Five methods of locating the voltage thresholds are given. A second discontinuity in the isochromats within a few volts of the quantum limit is obtained. By means of the experiments, determinations of h/e and $e/h^{3/4}$ are possible, according to the assumptions made regarding the X-ray wave-lengths. The values obtained are respectively, $(1 \cdot 3762 \pm 0 \cdot 0003) \times 10^{-17}$ and $(2 \cdot 0720 \pm 0 \cdot 0004) \times 10^{10}$. The agreement with the results, obtained by the same experiment by other investigators, is reasonable. The discrepancy between these values and those obtained by other experiments is discussed and possible causes for it are considered. It is claimed that the discrepancy is not due to errors in these short wave-length limit experiments. G. O. B.

2150. K-Transition in Elements from Al to W. H. Rindfleisch. *Ann. d. Physik*, 28. 5. *pp.* 409–437, *March*, 1937.—A number of new measurements of the mass absorption coefficients μ_k/ρ and μ_l/ρ on either side of the K-edge, for a series of 8 elements and for NH_4Br, have been made by the Küstner method. The effect of characteristic secondary radiations from the filter is shown to be small; and investigations were also carried out on the effect of fine holes in the filter material. The results of the absorption experiments show that there is a continuous relationship to within 1·8 %, between the ratio μ_k/μ_l and the atomic number. Comparisons are made between the experimental values of μ_k/μ_l and the formula of Jönsson for τ_k/τ_l, and even when allowance is made for scatter, large discrepancies are found. It is suggested that the formula is now inadequate. Theoretical work shows that μ_k/ρ and μ_l/ρ can be expressed as functions of $k\lambda^s$ or KZ^t, where k, K, s and t are constants. When σ/ρ, the scattering absorption is known, the K absorption jump τ_k/τ_l can be calculated from these functions. J. E. R.

2151. Fine Structure in X-Ray Absorption Spectra of Molecular Gases. B. W. Bogdanovich. *Phys. Zeits. d. Sowjetunion*, 11. 1. *pp.* 83–94, 1937. *In English.*—An exact formula for the fine structure of X-ray absorption spectra of triatomic molecules is given. This formula is applied to the case of a linear triatomic molecule. In the linear molecule two different configurations are possible; the fine structure of X-ray absorption for these configurations is different. It is shown that the investigation of the fine structure is a new method of investigating molecular structure, which can sometimes solve questions inaccessible by other methods. The influence of exchange on the fine structure of X-ray absorption spectra of diatomic molecules is investigated. The influence of nuclear vibrations on the fine structure is studied for diatomic molecules. AUTHOR.

***2152. Precision Two Crystal X-Ray Spectrometer. J. W. M. DuMond and D. Marlow.** *Rev. Sci. Instruments*, 8. *pp.* 112–121, *April*, 1937.—This article describes the design and construction of a 2-crystal X-ray spectrometer for the study of radiation of wave-length from (but not including) the vacuum region to about 100 X.U. Versatility coupled with precision of angular measurement is obtained by the use of worm gears, the spacing of whose teeth has been corrected by a relatively cheap but effective lapping method herein described. AUTHORS.

See also Abstracts 1921, 2052, 2267.

HEAT.

CALORIMETRY.

2153. Specific Heats of Sucrose Solutions and Apparent Molal Heat Capacity of Non-Electrolytes. F. T. Gucker, Jr. and F. D. Ayres. *Am. Chem. Soc., J.* 59. *pp.* 447–452, *March*, 1937.—The specific heats of solutions of sucrose have been determined at 20 and 25° by means of a differential apparatus employing adjustable heaters. The apparent molal heat capacity of sucrose is not constant, although it increases with concentration considerably less than a uni-univalent strong electrolyte. It is much more nearly a linear function of the first power than of the square root of the concentration. Its change with concentration decreases with rising temperature. Its limiting value at low concentration increases more rapidly with temperature than the same property of most electrolytes. The apparent molal heat capacity can be expressed satisfactorily as a second degree power series in the molality, and values of the apparent and partial molal heat capacities and the specific heats calculated by these equations are tabulated. A review of other available specific heat data for non-electrolytes shows a general decrease of apparent molal heat capacity with concentration, with greater deviations at low temperatures. AUTHORS.

2154. Heat Capacity, Entropy and Heat of Fusion of CS$_2$. O. L. I. Brown and G. G. Manov. *Am. Chem. Soc., J.* 59. *pp.* 500–502, *March*, 1937.—The heat capacity and heat of fusion of CS$_2$ are measured. The entropy calculated from calorimetric data agrees with the spectroscopic value within the experimental error. The entropy of liquid CS$_2$ at 298·1° K. is found to be 36·10 E. U. AUTHORS.

2155. Heat Capacities of Molybdenite and Pyrite at Low Temperatures. C. T. Anderson. *Am. Chem. Soc., J.* 59. *pp.* 486–487, *March*, 1937.—The heat capacities of FeS$_2$ (pyrite) and MoS$_2$ (molybdenite) from about 56 to 300° K. are measured and their corresponding entropies determined as 12·7 and 15·1 respectively. AUTHOR.

2156. Heat Capacities of Chromium and Its Compounds. C. T. Anderson. *Am. Chem. Soc., J.* 59. *pp.* 488–491, *March*, 1937.—The heat capacities of chromium, chromic oxide and chromous and chromic chlorides at low temperatures are determined and their corresponding entropies calculated as 5·68, 19·4, 27·4 and 28·2 respectively. AUTHOR.

2157. Heat of Sublimation of Graphite. G. Herzberg, K. F. Herzfeld, and E. Teller. *J. Phys. Chem.* 41. *pp.* 325–331, *Feb.*, 1937.—The difference between the value 177 k.cal. for the heat of sublimation of graphite (Marshall and Norton) and the spectroscopic value, 124 k.cal., is explained by the consideration that in the process of evaporation in a vacuum employed for the former value, two C-C bonds have to be broken for every alternate C atom, instead of the average 3/2 bond. The spectroscopic value is the average value. C. B. A.

See also Abstracts 1868, 1922, 2158, 2161.

CONDUCTION.

2158. Exchange of Energy Between Organic Molecules and Solid Surfaces. Part II. Accommodation Coefficients and Specific Heats of Paraffin Hydrocarbons. O. Beeck. *J. Chem. Phys.* 5. *pp.* 268–273, *April*, 1937.—The investigation of the accommodation coefficients of the paraffin hydrocarbons and their relation to the specific heats reported in Part I of this series [see Abstract 5189 (1936)] has been extended to various temperatures of the Ni surface and to various gas temperatures. The results are, within the experimental error of about 1 %, in full agreement with the general formulæ derived in Part I, by which the accommodation coefficients of the paraffins were related to their molecular weights and their specific heats. A complete summary of these relations is given at the end of this paper. AUTHOR.

2159. Thermal Conductivity of Insulating Materials. J. A. Weh. *Gen. El. Rev.* 40. *pp.* 138–140, *March*, 1937.—Describes an electrical method of measuring the thermal conductivity of solid dielectrics. The insulating material is placed between a cold plate and a hot plate electrically heated and consisting of a main heater, guard ring and a bottom plate, the latter two acting as thermal guards to the main heater. The thermal conductivity is derived from measurements of the heat flow, the temperature drop across the dielectric and the dimensions of the specimen. Values of the thermal conductivity of a number of typical insulating materials are given. E. R.

2160. Thermal Conductivity at Low Temperatures. W. J. de Haas and T. Biermasz. *K. Onnes Lab., Leiden, Comm. Nos.* 241–252, *Suppt. No.* 82b. [13 *pp.*], 1936. *In French.*—The experiments in thermal conductivity are divided into two groups: (1) those on metals, (2) those on non-conducting crystals. In the first group the resistance has been determined of Hg which becomes supraconducting: it is shown that a magnetic field superior to the perturbing field diminishes the thermal resistance below the point of transition. For supraconducting alloys the phenomena are less simple, above all from the point of view of the influence of the magnetic field. The thermal resistance of Cu, W, and Bi, metals which are not supraconducting has also been determined. In the second group, for non-conducting crystals, the resistance of quartz has been determined, along the principal axis, and perpendicularly to that axis. A strong increase of resistance has been found below 10° K., which is not in accordance with the theory of Peierls. The diamond and KCl exhibit also an increase of resistance at low temperatures, an increase which in the case of KCl is proportional to $T^{-1\cdot6}$. J. J. S.

2161. Simultaneous Determination of the Specific Heat and Thermal Conductivity of Insulators by the Signal Method. P. Vernotte. *Comptes Rendus*, 204. *pp.* 563–565, *Feb.* 22, 1937.—The method consists, in principle, in applying a given *flux* of heat to one face of a plate of the material and in measuring the rise in temperature of the opposite face from the initial instant when the whole system is at uniform temperature. In practice a symmetrical arrangement is employed with the resistance thermometer enclosed between two plates of the material. To the outer faces of these plates similar electric heaters are applied which are themselves enclosed by further plates of the material. Measurement ceases when the temperature rise reaches about 0·5°. For the materials tested this occurred after about 2 min. The specific heat and thermal conductivity found for ebonite of density 1·20 are quoted. W. S. S.

See also Abstract 2172.

CONVECTION.

2162. Electro-Convective Cellular Vortices. D. Avsec and M. Luntz. *Comptes Rendus,* **204.** *pp.* 757–759, *March* 8, 1937.—The types of electro-convective cellular vortices [see Abstract 1718 (1937)] obtained when the electrodes are (*a*) parallel rectangular plates and (*b*) coaxial cylinders, are described and illustrated by photographs. In each instance vortices alternating in direction are observed, the distances between the centres of similar vortices being approximately equal to the distance between the electrodes. In the cylindrical case the motion has no thermal analogue, a number of " belts " being fomed, in which the trajectories of the particles lie in the radial planes of the cylinders. R. W. P.

2163. Influence of Laminar Film on Heat Transfer at High Velocities. M. Schirokow. *Techn. Phys., U.S.S.R.* **3.** 12. *pp.* 1020–1027, 1936. *In German.*—A theoretical investigation showing that at high gas velocities a linear temperature gradient can no longer be assumed within the boundary layer. New equations are developed giving the quantitative heat interchange at high velocities from the gas to the walls, for flow over a plane surface and within a cylindrical pipe, which allow for the influence the laminar film has on the heat transfer. The magnitude of this depends on the factor Pr–1, (Pr being Prandtl's number), as at normal velocities, and so still plays no great part in promoting the heat transfer. R. W. P.

2164. Heat Transfer by Radiation. W. Heinze and S. Wagener. *Zeits. f. techn. Physik,* **18.** 3. *pp.* 75–86, 1937.—The problem considered is the determination of the temperatures of n bodies radiating to one another when the absorbing power, thermal conductivity and the dependence of energy radiated on temperature is known for each body. The total energy falling on one body is shown to be a linear function of the energies radiated to n bodies on the one hand and reflected from them on the other. Thus $2n$ linear equations are obtained for the $2n$ unknown energy magnitudes. When these are evaluated the temperatures of each body can be derived. The method is applied to a system of four rectangular plane surfaces arranged in open square formation, one of them being electrically heated. The measured and calculated surface temperatures agree to about 2 %. R. W. P.

DILATATION.

2165. Apparent Volumes and Thermal Expansions of Salts in Glycol and Methanol. R. E. Gibson and J. F. Kincaid. *Am. Chem. Soc., J.* **59.** *pp.* 579–584, *March,* 1937.—The specific volumes at 25° and the expansion coefficients are measured near this temperature of solutions of some salts in methanol and glycol. A comparison of the apparent and partial volumes of LiBr in water, glycol and methanol gives strong evidence that this salt influences the structure of water by promoting the tetrahedral arrangement of the molecules. Unlike the same quantities for salts in aqueous solution, the apparent molal expansibilities of the salts in glycol and methanol are negative and increase with the concentration of salt, thereby agreeing qualitatively with the predictions of the interionic attraction theory and the effective pressure hypothesis. A comparison of the behaviour of the salts in water on the one hand

and in glycol and methanol on the other indicates that the structural changes in water play a predominant rôle in determining the thermal expansions of aqueous solutions. AUTHORS.

See also Abstracts 1923, 2187.

MELTING AND BOILING POINTS.

2166. Boiling Points of Organic Compounds. Part I. Formula of Boggia-Lera. Part II. Properties of Paraffins. A. H. W. Aten, Jr. *J. Chem. Phys.* 5. *pp.* 260–267, *April*, 1937.—One or two formulae for the boiling points of organic compounds are first discussed, and published data are shown to fit the formula $T = (n.D + B)^{\frac{1}{2}}$, where T is the boiling point, *n* the number of CH_2 groups, and D. and B are constants. It is shown that D has a constant value for a homologous series, and a value of 20,500 fits most of the paraffins and their mono-derivatives quite accurately. It is also shown that this formula is fairly satisfactory for paraffin derivatives having a group at each end and for those having a substituent in the middle. Part II considers the theoretical basis of the formula. The square root is derived in the case of the paraffins from Langmuir's ideas about the process of evaporation of liquids and van Laar's and van Arkel's rules about cohesion in liquids, combined with empirical expressions for the critical constants. It is impossible to prove theoretically the validity of the formula of Boggia-Lera for other compounds, as there are not sufficient data available. E. H. D.

2167. Boiling-Point—Composition Diagram of the System Dioxane-Water. E. R. Smith and M. Wojciechowski. *Bureau of Standards, J. of Research,* 18. *pp.* 461–465, *April*, 1937.—Dioxane and water form a positive homoazeotrope which has an azeotropic decrease in temperature sufficiently large to effect the complete removal, by fractional distillation through an efficient column, of water present as an impurity. The boiling-point—composition diagram, including the composition of the vapour in equilibrium with the boiling liquid, was determined. The normal boiling point of dioxane was found to be 101·320° C. AUTHORS.

2168. Boiling Points and Densities of Acetates of Normal Aliphatic Alcohols. M. Wojciechowski and E. R. Smith. *Bureau of Standards, J. of Research,* 18. *pp.* 499–504, *April*, 1937.—The boiling points, rates of change of boiling point with pressure, and densities of methyl acetate, ethyl acetate, *n*-propyl acetate and *n*-butyl acetate were measured by precise comparative methods using water as the reference standard. As in previous work on the normal saturated hydrocarbons and normal aliphatic alcohols, it was found that the introduction of each CH_2 group into the chain of a molecule containing a normal alykl group of more than some small number *n* of carbon atoms causes dt/dp to increase by a constant value which is independent of the chemical nature of the molecule. AUTHORS.

2169. Relation Between the Melting Point, Boiling Point and Critical Constants and the Number of Carbon Atoms in Homologous Series. J. H. C. Merckel. *K. Akad. Amsterdam, Proc.* 40. 2. *pp.* 164–173, 1937. *In German.*—In a previous paper it was shown that the surface tension of aqueous solutions of fatty acids is, for a range of concentrations linear with the capillary activity number K, defined by the equation $K = a + n(n-l)/2v$, *a* and *v* being constants and *n* the number

of C atoms. This relation is further considered briefly and then the relation between the number of C atoms and the above-mentioned properties is considered, the sources of the values being given. In all cases the relations are rather complicated, and it is sometimes necessary to break the series up into two or more sets for small, medium and large number of C atoms.
E. H. D.

2170. Numerical Factor of Discontinuous Law of Curie and Melting Points. R. Forrer. *Ann. de Physique*, 7, *pp.* 429–458, *March*, 1937.—Application of the relations $T = FN^{\frac{1}{2}}$ and $F = F_0 + m\tau$ ($\tau = 14°$) [see Abstract 764 (1937)] is illustrated by a large number of examples of melting, transformation and Curie points. By allowing *m* to be a whole number or 1 ± ½ or ± 1/3, and accepting as sufficiently near a figure within 2° of the actual experimental point a large number of favourable examples is found. No physical meaning is assigned to F which remains a purely empirical quantity.
C. A. S.

***2171. Action of Rectification Columns. H. Hausen.** *Zeits. f. angew. Math. u. Mechanik*, 17. *pp.* 25–37, *Feb.*, 1937.—The author discusses this matter theoretically on the assumption that all mixing of the fluids is prevented. Three cases are discussed: (1) the vapour enters the tray at a constant concentration, (2) the liquid flows in the same horizontal direction at all trays and (3) the horizontal direction of flow of liquid changes from tray to tray. The exchange ratio is shown to be dependent upon two dimensionless magnitudes, viz. the inclination and curvature, of the equilibrium curve.
J. S. G. T.

2172. Energy and Material Interchanges at Surfaces. A. Eucken. *Naturwiss*, 25. *pp.* 209–218, *April* 2, 1937. From a consideration of a number of examples, including the condensation of water vapour in the form of both drops and thin films, the critical condensation temperatures of metal vapours, and the accommodation coefficients of gases, it is shown that an energy transfer usually accompanies a material transfer at the bounding surface between gas and solid. This is particularly true for processes involving absorption, and, on the other hand, the material transfers concerned are conditioned by the energy flow. A satisfactory explanation of the molecular processes called into play at the boundary can only be forthcoming if the two effects are considered jointly. R. W. P.

See also Abstracts 1927, 2191.

TEMPERATURE, MEASUREMENT OF.

2173. Thermodynamic Temperature Scale Below 1° Abs. N. Kürti, P. Lainé, and F. Simon. *Comptes Rendus*, 204. *pp.* 754–756, *March* 8, 1937.—Using an ammonium iron alum crystal and the method of adiabatic demagnetisation, the absolute scale was investigated below 1°. The absolute temperature T corresponding to T' on an arbitrary scale can be found from the variation of entropy δS of the substance over $\delta T'$ and the difference of total heat Q over $\delta T'$. Determinations of the variation of S and Q as a function of T' are described, and curves for T' as a function of T, for specific heat and for entropy are given and discussed. The susceptibility increases rapidly at about 0·03° Abs.
N. M. B.

***2174. Construction and Sensitivities of Short-Period Platinum Thermometers. J. J. Manley.** *Phil. Mag.* 23. *pp.* 695–701, *April*, 1937. *Supplement.*—In order to measure small changes in the melting points of certain materials after intensive drying it was decided to use Pt thermometers of short period. The requirements were minimum heat capacity; maximum resistance for the limited bulb volume; instantaneous response to small temperature changes. Twenty thermometers were constructed and tested, and some of these are here illustrated and briefly described. Experiments were carried out to determine the rate of cooling of the thermometers in air and in water, and the results obtained are tabulated. E. H. D.

THERMOCHEMISTRY.

2175. Intrinsic Energies of the C-C and C-H Bonds in Hydrocarbons. M. Brutzcus. *Comptes Rendus,* 204. *pp.* 490–493, *Feb.* 15, 1937.—The intrinsic bond energies of C-C and C-H links, evaluated from thermochemical and spectroscopic data are 223·5 and 167·7 k.cal. respectively. [See following Abstract]. W. R. A.

2176. Thermochemistry of Hydrocarbons. M. Brutzcus. *Comptes Rendus,* 204. *pp.* 574–576, *Feb.* 22, 1937.—Calculations based on previous results [see preceding Abstract] confirm 456·6 k.cal./gm. atom as the intrinsic calorific power of the C atom, and indicate that bivalent C is present, and consequently double and treble linkages absent, in CO and unsaturated hydrocarbons such as C_2H_4, C_2H_2 and cyclohexane, and that in C_6H_6 there are nine single linkages, implying that three of them connect pairs of diagonally opposite C atoms. [See following Abstract]. C. A. S.

2177. Yields of Combustion of Hydrocarbons and Energy Values of the Linkages of their Atoms. M. Brutzcus. *Comptes Rendus,* 204. *pp.* 859–861, *March* 15, 1937.—An alternative method of arriving at the figure 456·6 [see preceding Abstract] is given. Then follow methods of calculating the calorific yield of an unsaturated hydrocarbon, exemplified by application to C_2H_2, of which the yield is 124·68 k.cal.; of deducing 105–106 k.cal. as the average evolution of heat per molecule O_2 in the combustion of hydrocarbons in general, which applied to CH_4 gives 105·81 k.cal.; and lastly of determining 102·72 k.cal. as the value of the valency change V_2–V_4. C. A. S.

2178. Flame Propagation in Constant Pressure Bombs. L. Khitrin. *Techn. Phys., U.S.S.R.* 3. 12. *pp.* 1028–1033, 1936. *In English.*—The constant pressure bomb method developed by Stevens, and applied to the determination of the normal speed of flame propagation in gases is based on the supposition of complete spherical propagation of the flaming surface, and on equal and symmetrical expansion of the spherical soap film. Special verifications of these suppositions using an instantaneous photographic method showed that they are valid, and consequently the calculations proposed by Stevens are also valid. The constant pressure bomb method should give results in agreement with those found by the burner method, and the verification of this should be the object of special tests. [See following Abstract]. AUTHOR.

2179. Influence of Pressure on the Normal Flame Propagation Velocity in Gases. K. Kolodtsew and L. Khitrin. *Techn. Phys., U.S.S.R.* 3. 12. *pp.* 1034–1043, 1936. *In English.*—The constant pressure bomb method [see preceding Abstract] is the most thorough method for the measurement of the normal speed of flame propagation and is fully applicable to work at high pressures (densities). The constant pressure bomb and burner methods may be considered as the only methods at present existing which allow of the measurement of the actual value of the normal speed of flame propagation in gases. The value of the linear normal speed of propagation decreases with pressure for gas-air mixtures, within the pressure limits studied, and does not depend on the pressure in any way in the cases of mixtures with O_2. The value of the mass velocity of propagation grows with increase of pressure, in the case of O_2 mixtures it takes the form of straight line proportionality, and for air mixtures $m = k_1 \sqrt{p} + k_2$. The character of the change of the linear and mass velocities with pressure, for air mixtures is analogous with the effect observed using the burner method, and this character may be considered as being independent of the method of measurement. AUTHORS.

2180. Lower Limit of the Reaction Between Hydrogen and Oxygen. A. Biron and A. Nalbandjan. *Acta Physicochimica,* 6. 1. *pp.* 43–56, 1937. *In English.*—Reference is made to the theory of the lower limit of inflammation worked out by Semenoff and by Bursian and Sorokin. A relation is found between the partial pressure of the H_2–O_2 mixture at the lower limit and the amount of inert gas added in re-fused pyrex vessels. The same relation is tested in a quartz vessel and the data obtained compared with that found by Hinshelwood and Moelwyn-Hughes. The relation between the lower limit and percentage composition of the mixture is also investigated in view of the contradictory results obtained by previous workers. The apparatus and method of experiment are described. J. K.

2181. Explosive Limits of Gaseous Mixtures. M. Rivin and A. Sokolik. *Acta Physicochimica,* 6. 1. *pp.* 105–114, 1937. *In French.*—The limits of explosion are determined for mixtures containing CO and for those containing CH_4. CO–H_2–O_2 mixtures of various compositions are examined and it is shewn that an increase in H_2 concentrations leads to a variation in the limit of explosion similar to that of a change in temperature of inflammation and of velocity of propagation of flame. CH_4–O_2–N_2 mixtures are also examined. The specific character of the explosive wave for mixtures of CO–O_2 and CH_4–O_2–N_2 can be explained by the existence of two possible structures for the wave. [See Abstract 2793 (1936)]. J. K.

2182. Low-Temperature Spontaneous Combustion of Hydrocarbons. B. V. Aivazov and M. B. Neumann. *Acta Physicochimica,* 6. 2. *pp.* 279–288, 1937. *In English.*—It is shown that the low-temperature combustion of pentane proceeds in two stages. The formation of a cold flame precedes the spontaneous ignition so that the induction period τ can be divided into two components: τ_1—the induction period of the cold flame, and τ_2—the time between the initiations of the cold and hot flames. It is shown that certain aspects of the combustion process in engines working on light and heavy fuels can be explained on the basis of the two-stage mechanism. AUTHORS.

***2183. Ionisation and Pressure during Explosions of Solid Explosives. M. Sąsiadek.** *Zeits. f. Physik,* 104. 7–8. *pp.* 566–579, 1937.—An apparatus is first described, a type of manometer bomb, for the simultaneous registration of the course of ionisation and pressure during the explosions of smokeless and black powders, and of Ag, K and Cu picrates. It is established from a comparison of the ionisation and pressure curves that the former is displaced with respect to the latter and takes a deviating course. It is also found that both the ionisation current and the total charge rise more rapidly than the applied voltage, and that the duration of the ionisation process is independent of the voltage, also that the

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ionisation current increases proportionally with the charge density. The results obtained favour the view point that ionisation is primarily the result of chemical reactions, and not exclusively due to the high temperature of the products of combustion. The empirical dependence of the ionisation current as a time function was established. H. H. Ho.

2184. Latent Energy in Combustion. W. T. David. *Phil. Mag.* 23. *pp.* 345–355, *March*, 1937.—During the passage of flame through an inflammable gaseous mixture, it seems that a stable form of latent energy is created in the flame front and this remains in the flame gases left behind. The latent energy probably resides in metastable molecules which result from reactions in the flame front. The experimental evidence for this view is obtained by means of the photographic study of the intensity and duration of the afterglow in flame gases, the continuous measurement of the temperature of thin Pt-Rh wires immersed in these gases and the continuous pressure and heat loss measurements during explosion and subsequent cooling of gaseous mixtures in closed vessels. H. J. H. S.

2185. Ignition of Gaseous Mixtures by Hot Particles. R. S. Silver. *Phil. Mag.* 23. *pp.* 633–657, *April*, 1937. *Supplement.*—A description is given of an experimental method for the determination of the lowest temperature at which a hot sphere will cause ignition of a gaseous mixture of known composition. Results are given for spheres of platinum and quartz having diameters ranging from 1 to 6 mm. With coal-gas-air, pentane-air and hydrogen-air mixtures the temperature of igniting falls off rapidly with increase of sphere diameter. Only in the case of hydrogen-air mixtures is a small specific difference between platinum and quartz observed. In every case the minimum temperature of igniting is much above the known "ignition temperature" of the mixture. An approximate form of theory, which describes the results qualitatively, is suggested on the assumption that extinction is due to cooling by conduction to the unburnt parts of the gas. Finally this thermal theory is discussed in relation to the chain character of the molecular reactions. L. A. W.

See also Abstracts 2157, 2189, 2191.

THERMODYNAMICS.

2186. Density Curve and Diametral Line of Krypton. E. Mathias, C. A. Crommelin, and J. J. Meihuizen. *Comptes Rendus*, 204. *pp.* 630–633, *March* 1, 1937.—These experiments follow on those on other gases, which have been reported, and the apparatus used for the density determinations was practically the same as that previously described. The purification is briefly described, and the results are tabulated assuming the value 3·743, of Heuse and Otto, for the weight of one litre of krypton, in gms., under standard conditions. The values obtained for the various constants are critical coefficient $K = 3\cdot443$, critical temperature $T_c = 209\cdot39$, critical density $= 0\cdot9085$, critical pressure $= 54\cdot108$ atmos. The value of K is high; Kr also shows the characteristics of A, Ne, C_2H_4, and CO_2 in that the real diameter is not collinear with the rectilinear diameter, throughout its length. Finally, it is concluded that within these limits Kr obeys the law of rectilinear diameters. E. H. D.

2187. Condensed Phases of Helium and Hydrogen. A. Bijl. *Physica*, 4. *pp.* 329–344, *April*, 1937. *In English.*—The influence of the zero-point motion on the density of a crystal is discussed and the result applicated to $H_2 + D_2$. The zero-point motion affects also the specific heat, which is at the lowest temperatures determined by the velocity of sound. The latter could be calculated by considering the influence of an elastic deformation on the wave-function of the crystal. The result is that the square of the velocity of sound can be obtained as a sum of the contributions of the potential energy and the kinetic energy; in the case of solid He and H_2 good agreement with experimental results is obtained if the molecules are treated as hard spheres. As a consequence it is shown that at very small densities a negative thermal expansion may be expected. AUTHOR.

2188. Enthalpy Diagram of Nitrogen. I. M. Gusak. *Phys. Zeits. d. Sowjetunion*, 11. 1. *pp.* 60–68, 1937. *In English.*—The isothermal expansion coefficient of N_2 is determined between 60 and 200 atmos. at 115·1°, 167·1°, 194·6°, 273·1° and 291·6° K. From the results obtained the enthalpy diagram determined up to 60 atmos. by the U.S. Bureau of Mines is continued up to 200 atmos. It is shown that the *i–S* and *T–S*–diagrams of N_2, constructed by Keesom and Houthoff, are not sufficiently accurate. AUTHOR.

2189. Entropy of Water From the Third Law of Thermodynamics. W. F. Giauque and R. C. Archibald. *Am. Chem. Soc., J.* 59. *pp.* 561–569, *March*, 1937.—The heat capacities of magnesium oxide and magnesium hydroxide have been measured from 20° to 300° K. and 20 to 320° K., respectively, from which it was found that the low-temperature heat capacity of magnesium oxide prepared by the decomposition of magnesium hydroxide at 300–350° C. was definitely greater than the heat capacity of crystalline material prepared from the fused oxide. The dissociation pressure of the system $Mg(OH)_2$, MgO has been measured accurately at 463·1 and 485·0° K. The pressures found were 1·991 and 5·439 international cm. respectively. It is suggested that dissociation equilibria should be first approached from the low-temperature side, and that subsequent attainment of the same value from the high-temperature direction may be taken as substantial evidence of the equilibrium. The heat of solution of one mole of $Mg(OH)_2$ in 10500 c.c. of molal HCl was found to be 26763 cal. at 25° C., and that of MgO + 1 mol. of water was 36498 cal. These measurements, when corrected for the partial molal heat content of water in the solution, lead to a value of $\Delta H_{298 \cdot 1^\circ K} =$ 9738 cal. for the dissociation of one mole of $Mg(OH)_2$ to give MgO and pure liquid water. By means of the third law of thermodynamics the molal entropies of gaseous water at 485·0, 463·1 and 298·1° K., are calculated to be 49·11, 48·65 and 45·10 cal./deg., respectively; the corresponding values obtained from band spectrum data are 49·10, 48·72 and 45·13 cal./deg., respectively. The free energy for the dissociation of magnesium hydroxide is, $Mg(OH)_2 = MgO + H_2O(g)$. $\Delta F_{298 \cdot 1^\circ K} =$ 9297 cal./mol. H. H. Ho.

2190. Thermodynamics of KOH Solutions. H. S. Harned and M. A. Cook. *Am. Chem. Soc., J.* 59. *pp.* 496–500, *March*, 1937.—Measurements of the e.m.f.s. of the cell $H_2|KOH(m)|K_xHg|KOH(0 \cdot 05)|H_2$ are made from 0 and 35° inclusive at 5° intervals and *m* is varied from 0·1 to 4 *M*. From these data, the activity coefficient, relative partial molal heat content, and the relative partial molal heat capacity are computed. Satisfactory agreement with similar results derived from calorimetric data is obtained. AUTHORS.

See also Abstracts 1924, 2154, 2169, 2173, 2192, 2222.

VAPOUR PRESSURE.

2191. Vapour Tension of Mixture of Phosphoric and Nitric Acids. E. E. Babkin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 4. *pp.* 193–196, 1937. *In English.*—Phosphoric acid is becoming increasingly important in chemical technology, and much work is being done on the replacement of sulphuric by phosphoric acid in the manufacture of concentrated nitric acid. There is a considerable amount of resemblance between these two acids, and this fact was used in considering experiments on the boiling points and the composition of the vapour phase in the ternary mixture H_3PO_4–HNO_3–H_2O. The preparation of the component substances is briefly described, and the apparatus used resembled that due to Pascal. The general acidity, nitric acid, and samples of the distillate were determined by suitable titrations, and the phosphoric acid was determined by the precipitation method according to Schmitz. The partial pressure of the nitric acid vapour was obtained from the nitric acid content of the distillates. Results are given in tabular and graphical form, and the boiling points of the mixtures are plotted in a Gibbs triangle. E. H. D.

2192. Vapour Pressures of Liquid Nitrogen and of Solid Nitrogen β. W. H. Keesom and A. Bijl. *K. Onnes Lab., Leiden, Comm. No.* 245*d. Physica,* 4. *pp.* 305–310, *April,* 1937. *In English.*—Vapour pressures of liquid nitrogen below 1 atmos. and of solid nitrogen β are determined. For the normal boiling point is found: $t_N = -195{\cdot}78_7$ °C. ($77{\cdot}35_7$ °K.) and for the constants of the triple point: $p_{tr} = 9{\cdot}401$ cm. Hg, $T_{tr} = 63{\cdot}15_0$ ° K. AUTHORS.

ACOUSTICS.

2193. Finite Acoustic Filters. R. B. Lindsay. *Acoustical Soc. of America, J.* 8. *pp.* 211–216, *April,* 1937.—Most of the previous theoretical work on acoustic filtration has dealt with idealised infinite structures. The present paper is a theoretical study of finite filters such as are used in practice. Considering an acoustic structure with air as the medium with main line impedance Z and with n branch impedances Z_b (pure reactances) equally spaced at intervals $2l$, the power transmission ratio for the structure can be expressed in the simple form $P_r = 1/\{1 + (Z^2/4|Z_b|^2)(\sin^2 nW/\sin^2 W)\}$, where $\cos W = \cos 2kl + iZ/2Z_b \cdot \sin 2kl$, the familiar parameter of the transmission theory of filtration. The plot of P_r as a function of frequency shows the presence of transmission and attenuation bands which approach those of the corresponding ideal infinite case as n becomes large compared with unity. Comparision with the actual transmission measurements of Stewart shows satisfactory agreement. The phase change which occurs between successive sections in a filter is also computed and it is shown that unlike the situation in the infinite case the phase change is a function of the section. However, at relatively high frequencies and for large n this approximates to the total phase change along the structure divided by n. Comparison with such experimental results as are at present available yields reasonably satisfactory agreement. [See also Abstract 3766 (1936).] AUTHOR.

2194. Detection and Location of Laminations in Steel Plates. H. C. Hayes. *Acoustical Soc. of America, J.* 8. *pp.* 220–226, *April,* 1937.—Laminations in the plating and other members of fabricated steel structures cause weaknesses and failures in present welded junctions that did not occur in the case of rivetted joints. Thus the need has arisen for some effective method and means for detecting such flaws in structural steel material. Simple theoretical considerations predict that the presence and location of such laminations can be determined by the distortion which they produce in sand patterns formed on the plates when they are thrown into various types of mechanical resonance. Practical tests have substantiated these predictions in the case of plates of different form and thickness. AUTHOR.

2195. Vibrating String Considered as an Electrical Transmission Line. W. E. Kock. *Acoustical Soc. of America, J.* 8. *pp.* 227–233, *April,* 1937.—An analogy is drawn between the piano string and an electrical transmission line, utilising a different correlation from the one usual in electroacoustical analogues. The current in the line is compared with the displacement and the voltage is compared with the momentum. With this correspondence the highly developed treatment of transmission lines becomes applicable to the piano string. The various cases discussed include: Open circuited line with and without attenuation (*i.e.* ideal and actual string with ends rigidly fixed), terminated line (string affixed to bridge of soundboard), electrical impulse introduced (impact of piano hammer). A relation is derived giving the optimum position of striking point for a given ratio of hammer mass to string mass, and this is shown to agree with the results of George and Beckett [see Abstract 1825 (1927)]. The appearance of the nth harmonic when the string is struck at $1/n$th of its length is explained, likewise the advantages of the modern practice of high string tensions. Conclusions are drawn concerning impedance matching (string to soundboard) and the velocity of propagation for different frequencies. AUTHOR.

2196. Tables for Technical Acoustics. G. H. Domsch. *A.T.M. No.* 68. *T*21–*T*22, *Feb.*, 1937.—A useful set of four tables giving formulæ relating to speed of propagation of sound in solids, liquids and gases, to sound intensity, to reverberation and similar topics in architectural acoustics and to resonators. Each constant is defined algebraically, and separate columns are given to show the units in the c.g.s. system, the value for air at 20° C. and 760 mm. Hg, together with general comments including the values for other media, methods of measurement or small diagrams. W. H. Ge.

2197. Absorption of Ultrasonic Waves in Benzene. E. Baumgardt. *Comptes Rendus*, 204. *pp*. 416–418, *Feb.* 8, 1937.—The radiation pressure caused by ultrasonic waves produced by a disc of piezoelectric quartz at the bottom of a vessel containing benzene, on a brass cone filled with air, the diameter of which was > that of the disc, and which was placed at varying distances therefrom, was measured by attaching the cone to one arm of a balance. The coefficient of absorption, α_a, thence deduced was some 100 times > the theoretical value, $\alpha_a/N^2 \times 10^{17}$ (N = frequency) being 888–923 as compared with 8·66 theoretical. C. A. S.

2198. Supersonic Yield of Piezoelectric Quartz. E. Baumgardt. *Comptes Rendus*, 204. *pp*. 751–754, *March* 8, 1937.—Measurements are described of the supersonic yield of two quartz discs, the method being based on the pressure exerted by the waves on an obstacle in their path [see Abstract 4641 (1934)]. One face of the quartz is in contact with a liquid (water, benzene, or toluene). The resonance curves are all of the same form, and that around the frequency corresponding to the fifth harmonic is given. Experimental and calculated results are compared for the fundamental, and for the third and fifth harmonics. N. M. B.

2199. Propagation of Sound in Buildings. K. W. Wagner. *E.N.T.* 14. *pp*. 49–66, *Feb.*, 1937.—A mathematical investigation of the vibrational properties of double walls treated as resonant elements in a filter. The transmission of sound energy through a small hole in such a structure is also considered. L. E. C. H.

***2200. Standard Source of Sound. E. N. da C. Andrade and R. C. Parker.** *Roy. Soc., Proc.* 159*A*. *pp*. 507–526, *April* 15, 1937.—A source of sound of calculable intensity is described. It consists of a tube open at one end and closed at the other with a loud-speaker which is used to excite vibrations in the tube. The amplitude of the vibrations is determined from measurements of the amplitude of oscillation of MgO particles suspended in the air. The open end of the tube is fixed in an approximation to an infinite baffle, so that the intensity of the sound radiated is calculable. In order that the suspended particles shall accurately follow the air vibrations their diameters must be less than a certain size. To determine their diameters the Brownian motion is observed. The sound source is used to determine mimimum audibility for frequencies 646 ∼ and 410 ∼ and good agreement with previous observers is obtained. J. E. R. C.

2201. Transpositions of Speech Sounds. E. Bárány. *Acoustical Soc. of America, J.* 8. *pp*. 217–219, *April*, 1937.—Transpositions of speech sounds were observed when spoken with hydrogen in the air passages instead of air. The cavity resonances change upwards, at the most some two octaves, leaving only the fundamentals of the vocal cords unchanged The voice alters in a very marked way, but remains clearly understandable. Tyndall had tried this experiment in 1867. An articulation test was made in a room with an invisible speaker and seven observers. The speaker was provided with a stethoscope through which a masking noise could be introduced to his ears. Control series of Swedish syllables were arranged, and 27 were spoken with hydrogen and masking noise, 27 with air and noise, 18 with hydrogen and no noise, and 27 with air and no noise. The articulation of the first and last consonants and the vowels is tabulated in percentages, and it was concluded that the average articulation in hydrogen is about 75 per cent of that in air. The average concentration of H_2 in the air passages was considered to be about 80 p.c., and the speaker stopped when he felt physical signs of anoxæmia. The greatest part of the change due to the use of the lighter gas is attributed to changes in the resonance frequencies of the formant-determining cavities. G. E. A.

***2202. Sound Analysis. H. H. Hall.** *Acoustical Soc. of America, J.* 8. *pp.* 257–262, *April,* 1937.—Instruments for sound analysis may be grouped into five classes, graphic, resonance, heterodyne, stroboscopic, and diffraction analysers. The operation of each type of instrument is briefly described. From the point of view of analysis sounds may be classified roughly into four groups; (1) Steady state sounds or sounds which may be maintained at constant fundamental frequency, constant intensity and unvarying quality for long enough to carry out the analysis; (2) Sounds which are essentially transient in nature; (3) Sounds which may be maintained constant on the average but whose intensity, frequency, and wave form are modulated at a constant frequency; (4) Noise, or sounds which are entirely random in form but which are continuously maintained. The sound spectra corresponding to each group are described and the application of the various types of instruments to the analysis of these spectra is discussed. It is pointed out that a graphic analyser may not be used to analyse single waves taken from a short transient sound. AUTHOR.

***2203. Acoustic Impedance Bridge. N. W. Robinson.** *Phil. Mag.* 23. *pp.* 665–681, *April,* 1937. *Supplement.*—The development of an acoustical bridge for measuring acoustical impedances is described. The bridge consists of two similar tubes forming ratio arms, into which sound waves are propagated equally by a loud-speaker. The tubes are terminated by a known reactance standard and the unknown impedance respectively. The acoustical pressures at points equidistant along the ratio arms are balanced by adjusting the standard reactance. The balance is indicated by a differential microphone which acts as an acoustical galvanometer. Measurements were made on Helmholtz resonators and on orifices, and the results obtained verified those obtained by an independent single tube method. AUTHOR.

See also Abstracts 1954, 2054.

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ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***2204. Valve Amplifier for the Measurement of Small Charges. J. A. Chalmers and F. Pasquill.** *Journ. Sci. Instruments*, 14. *pp.* 127–131, *April*, 1937.—A two-stage valve bridge amplifier for the measurements of charges of the order of 10^{-4} to 10^{-5} e.s.u. upwards is described, and its calibration, characteristics and uses are discussed. AUTHORS.

See also Abstracts 1955, 2195, 2217, 2224.

CONDUCTION AND DISCHARGE IN GASES.

2205. Quartz-Mercury Arc with Electrodes of Low Work Function. W. T. Anderson, Jr. and L. F. Bird. *J.O.S.A.* 27. *pp.* 95–99, *March*, 1937.—A number of early attempts to substitute solid kathodes for the liquid Hg in the Hg vapour arc lamp are described and discussed. Most of these failed owing to the unsatisfactory materials or construction of the electrodes. In the lamp described the electrodes consist of a number of nested metal cups welded together and separated from one another by coatings of oxides of Zr, Al or Zn. The tube is filled with A at about 1 cm. Hg pressure and with a suitable amount of Hg vapour. The discharge in the A quickly heats the kathode surface, the arc strikes and owing to the conductivity of the electrode, temperature equilibrium is soon attained. It is claimed that the lamp is sufficiently robust for commercial use, and has a life of approximately 2000 hr. Detailed optical and electrical characteristics are given. The electrical efficiency is higher than the usual forms of quartz-Hg arcs owing to the lower electrode losses. J. E. R.

2206. Corona Discharge between Points in Hydrogen. R. W. Sloane. *Phil. Mag.* 23. *pp.* 534–545, *April*, 1937.—A discharge-tube with tungsten point electrodes is described, and results of measurements of the sparking potential and the current-potential characteristics of the tube, containing H_2 at various pressures, are given. It is shown that apparent "static" corona characteristics, obtained by measuring current and potential with instruments with massive moving parts, are in this case the loci of the centroids of dynamic characteristics. Results are given which show that, under certain conditions, the discharge may remain in the corona form, although the current rises for a short time to values much greater than the least stable glow current. The general form of the characteristics is the same at all pressures from 0·5 cm. to 45 cm. of mercury. AUTHOR.

2207. Anode Fall in H_2 and D_2. A. Güntherschulze and H. Schnitger. *Zeits. f. Physik*, 104. 5–6, *pp.* 395–401, 1937.—An earlier comparison of the glow discharge in H_2 and D_2 is followed up by measurements on the anodic portions of the glow discharge. In D_2 there is found in a pressure region from 1·3 to 5 torr. a 14·2 % smaller gradient and 7·1% smaller anode fall than in H_2. The optical density of the anode fall region was determined with sufficient accuracy by an improved method of measurement. The law $p.d._{opt.}$ = constant is fulfilled, in H_2 there is found for $p.d._{opt.}$ 1·36 mm. on the torr. and in D_2 1·24 mm. By means of tests at different distances from the anode the total electrical density of the anode fall region was determined. Here also the rule $p.\,d_{elec.}$ = constant holds good, but $p.d_{elec.}$ in H_2 is 5·0 mm. and in D_2 6·3 min. The electron temperature in the flat branch is 16·5% greater in D_2 than in H_2. J. J. S.

2208. Building-up Time of Glow Discharge. R. Schade. *Zeits. f. Physik,* 104. 7–8. *pp.* 487—510, 1937.—During investigations of ignition delay in Ne glow discharges, delay times not statistically distributed, but invariable, were observed, whose order of magnitude varied between 10^{-5} and 1 sec. according to the excess potential applied. An experimental investigation of the dependence of these delay times on the interval between two successive discharges, incident radiation, temperature and excess potential showed that we are in this case dealing with the building-up time of the discharge itself. Theoretical considerations require the building-up of the discharge to be essentially free from space charge effects. The expressions derived from Townsend's theory for the dependence of the building-up time on the primary current strength and the excess potential were verified experimentally. These relations also give the time behaviour of the building-up of gas amplified photoelectric currents. A. W.

2209. Influence of Pressure on the Excitation Potential of N_2^+ Bands. R. Bernard. *Comptes Rendus,* 204. *pp.* 488–490, *Feb.* 15, 1937.—The experimentally observed excitation potential of N_2^+ is to be regarded as the resultant of a number of excitations of varying degrees. In consequence there is a well-defined maximum value (48 V) which may be observed only at very low pressures when the electron free path becomes comparable with the distance between the electrodes. W. R. A.

2210. Passage of Alkali Ions Through Various Gases. F. Wolf. *Ann. d. Physik,* 28. 5. *pp.* 438–444, *March,* 1937.—Previous work on the ionic collision cross-section for the processes $Li^+ \rightarrow H_2$, He, Ne and $K^+ \rightarrow H_2$, He, in relation to the velocity of the ions, have been extended over a wider range of conditions. The results indicate that even when the ionic energy differs from the resonance value by a comparatively large amount, the effective cross-section never becomes zero; except in the case of $Li^+ \rightarrow He$, the cross-sections appear to have an end value of from 0·1 to 0·5 cm.^{2}/cm.^{3} J. E. R.

***2211. New Method of Focusing Beams of Positive Ions. L. Cartan.** *J. de Physique et le Radium,* 8. *pp.* 111–120, *March,* 1937.—A grid arrangement is described which assists in the electrostatic focusing of ions of up to 10^6ekV energy by potentials of a few thousand volts. The size of the image is the same as that which would result from a point source collimated by a hole equal in size to that of the mesh of the grid. Application of the instrument to a mass spectrograph of parabola type resulted in one-hundredfold increase in intensity accompanied by no decrease in resolving power. F. C. C.

***2212. High Velocity Positive Ions. J. D. Cockcroft.** *Brit. J. of Radiology,* 10. *pp.* 159–170, *March,* 1937.—A summary of the history, production and main properties of high-velocity positive ions. Among the generators of such ions a h.v. generator giving up to 6×10^6 V and the "cyclotron," giving ionic velocities equivalent to 5×10^6 V are discussed. Through the intermediary of neutrons, artificial radioactivity may be induced in many substances, and detected by sensitive Geiger counters. By using such activated substances, the migration of substances in animals and plants may be studied in detail. G. E. B.

2213. Discharge of Geiger-Müller Counters by Coincidence Method. Z. Ollano. *N. Cimento,* 13. *pp.* 451–464, *Dec.,* 1936.—Using different absorbing screens and varying the pressure of air between the counters arranged to register coincidence, Greiner's observation that a Geiger-Müller counter emits extreme u.v. radiation is confirmed. The absorption coefficient of the radiation in air is $2{\cdot}8 \times 10^3$ cm.^{2}/gm. corresponding to the band for N_2 at 1000 Å. This radiation is emitted by a counter while in action and is not considered to be responsible for the innate background discharges of the counter. F. C. C.

***2214. Sensitiveness of a Geiger Point Counter. B. Dasannacharya and T. S. K. Moorthy.** *Phil. Mag.* 23. *pp.* 600–620, *April*, 1937.—The β-ray sensitiveness of a Geiger point counter between the regions of its threshold potential and its saturation potential is found to depend on the path of ray inside the counter. With the point negatively charged, the farther the path lies from the point the more effective it is since the secondary ions released acquire a greater energy. At the saturation voltage the energy of the secondary particles is sufficient to give a count no matter where they are liberated so that the directional effect becomes negligible and the counts are conditioned only by the geometry of the beam. F. C. C.

See also Abstracts 1876, 1889, 2093, 2148, 2183.

CONDUCTION IN SOLIDS AND LIQUIDS.

2215. Quantum Theory of the Electrical Conductivity of Alloys in the Superlattice State. Part II. T. Muto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 683. *pp.* 153–160, *March*, 1937. *In English.*—The alloy does not always, at each temperature, take up the equilibrium state characteristic of the temperature, and hence the order of atomic arrangement is not specified by the equilibrium value of the separation distance S. The correct value of S depends on previous heat treatment, and this correct value is deduced by a simple and accurate method with the aid of measurements of relative intensities of X-rays reflected by the alloy. The X-ray structure factor is shown, by Laue's computation method, to depend explicitly on S. [For Part I see Abstract 5240 (1936).] N. M. B.

2216. Theory of Solids. Part II. F. Seitz and R. P. Johnson. *J. of Applied Physics*, 8. *pp.* 186–199, *March*, 1937.—Part I [see Abstract 1779 (1937)] gave the classical theories of the solid state, and sketched an outline of the modern wave mechanical theory. The valence electrons of a solid occupy an energy spectrum composed of zones of energy levels, and the observed differences among various solids can be correlated largely with differences in the distribution and population of these zones. In this paper are discussed each of the five main types of solids, to see what explanation the zone theory offers for their distinguishing peculiarities. Following this, the progress of the theory in interpreting certain structure-insensitive volume properties is very briefly reviewed. AUTHORS.

***2217. Attenuators and Voltage Dividers for Use at Radio-Frequencies. N. F. Astbury.** *Journ. Sci. Instruments*, 14. *pp.* 113–118, *April*, 1937.—The articles gives a general survey of the work done during the past ten years or so on the design of voltage-dividing devices for use at radio frequencies. The three main types (resistive, inductive and capacitative) are discussed, and it is suggested that a capacitance voltage divider may form a suitable " primary stand attenuator " against which others may be calibrated, the capacitance instrument itself being calibrated by l.f. bridge and other methods. It is concluded that a capacitance voltage divider is not only one of the most inexpensive types, but is also the most generally satisfactory, being usable at all frequencies up to the short wave band. N. F. A.

2218. Measurement of High Resistances. H. Gönningen. *E.T.Z.* 58. *pp.* 316–318, *March* 25, 1937.—Describes an electrostatic method of measuring the d.c. resistances of condensers, insulating materials, etc. The condenser or insulating material is first charged, and the source of voltage is then removed. The rate of fall of voltage of the condenser is measured by means of an electrostatic voltmeter. Resistances up to 10^{14} ohms can be measured by this method, using an applied voltage of only 140 V. E. R.

*** 2219. H.F. Chokes, Condensers and Resistors. L. Hartshorn and W. H. Ward.** *Journ. Sci. Instruments,* 14. *pp.* 132–135, *April,* 1937.—Experimental data are given showing the behaviour of typical circuit components at frequencies from 30–100 Mc./sec. AUTHORS.

2220. Supraconductivity. W. J. de Haas, O. A. Guinau and (Mme.) J. M. Casimir-Jonker. *K. Onnes Lab., Leiden, Comm. Nos.* 241–252, *Suppt. No.* 82*d* [19 *pp.*], 1936. *In French.*—Experiments in supraconductivity were made which bear on the penetration of the magnetic field in a supraconducting body. First by measurements of resistance the value of the critical field was determined which sufficed to destroy the supraconducting condition in cylindrical monocrystals. The penetration of the magnetic field in a cylindrical body was determined by means of the change of resistance of wires of Bi in a magnetic field. To diminish the difficulties caused by the form of the specimen the phenomena were studied in a sphere of Sn. Cylinders were used in the study of alloys. The field was found to penetrate to an amount at which the cylinder remains supraconducting. Only at a value of the field much higher does the supraconductivity disappear. To study the value of the resistance between these two fields a steady lasting current was employed which traversed a resistance consisting of an alloy and then a ring of Pb. The results given are accompanied by diagrams. J. J. S.

2221. Disturbance of Supraconductive State by a Magnetic Field. W. J. de Haas and (Miss) A. D. Engelkes. *K. Onnes Lab. Leiden, Comm. No.* 247 *Physica,* 4. *pp.* 325–328, *April,* 1937. *In English.* By means of an experiment in which both the resistance wire and the induction methods are used for the determination of the threshold magnetic field which just destroys superconductivity, it is shown that at 3·47° K. there is no difference between the values given by the two methods, whereas a difference of 15 % had been indicated by previous observers. The threshold curve is determined for Sn down to a temperature of 1·23° K. and extrapolations to 0° K. gives a value of 299 ± 2 gauss. R. W. P.

2222. Behaviour of a Certain Supraconducting Circuit. R. J. Duffin. *Phys. Rev.* 51. *pp.* 575–577, *April* 1, 1937.—The circuit considered consists of a hollow wire of one supraconducting metal and a return wire of another supraconducting metal inside the first wire. It is shown that under appropriate conditions the current is a function of the temperature. The application of thermodynamics to the system results in an equation equivalent to the latent heat relation of Casimir and Gorter. AUTHOR.

2223. Electrical Conductivity of Pure Metals. W. J. de Haas and G. J. van den Berg. *K. Onnes Lab. Leiden, Comm. Nos.* 241–252, *Suppt. No.* 82*a.* [10 *pp.*], 1936. *In French.*—Investigating the electrical

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resistance of pure metals as a function of the temperature an experimental study of their resistance has been made chiefly in the region of very low temperatures, *i.e.*, from 1° K. to 20° K. Modern theories of electrical conductivity give the formula $R/R_0 = AT^B$ where R is the resistance at T° K., R_0 that at O° C., and A and B constants, T^B being the absolute temperature to a single power. To verify this formula the resistance from 1° K. to 20° K. of the following pure metals has been determined: Pt, Au, Pt, Cu, Cd, Th, Sb, Ag. A brief summary of the results obtained with diagrams is given. J. J. S.

✱2224. Electrolytic Conductivity Measurement. F. Ender. *Zeits. f. Elektrochem.* **43.** *pp.* **217–233,** *April,* **1937.**—The general Wheatstone a.c. bridge-method affords only the ratio of the apparent resistances and the conditions have now been investigated under which the relationship of the active resistance in one half of the bridge shall coincide with that in the other half. The bridge can so be constructed that a direct reading is given of the active resistance of the electrolyte investigated. The two possibilities of the direct reading instrument have been vectorially elucidated. From an investigation of the convergence ratio of the bridge value by diagrammatic means, it is shown that the equalisation of the bridge by a series connection may be attained as rapidly as by a parallel arrangement of capacity and resistance. The sensitivity of the bridge connections have also been calculated to a relative accuracy of 1 : 500,000 ohms. and an equalisation of the time constant to $0{\cdot}5 \times 10^{-8}$ sec. The earthing of null indicator, bridge and generator is discovered. The dielectric loss in the conductivity cell has been investigated and experimental improvements discovered; the distance of the double layer from the electrodes is found to be 10^{-7} cm. Finally, for the evaluation of errors which arise through heating of the electrolyte during the measurements, both a computable, and an experimental method are described. An approximation formula for the error due to heating serves as a basis for the construction of three conductivity pipettes. H. H. Ho.

2225. Conductivity of Strong Electrolytes in the Amorphous State. P. P. Kobeko, E. V. Kuvshinski and N. J. Shishkin. *Acta Physicochimica,* **6. 2.** *pp.* **255–262, 1937.** *In English.*—The specific resistance (ρ) of H_2SO_4, $H_2SO_4 \cdot 2H_2O$, H_3PO_4 and a 25 % aqueous solution of KOH, as well as the viscosity (η) of H_2SO_4 were measured over a wide temperature range. T_g was determined for these substances, and also indirectly for water from the position of the bend on temperature—dielectric constant curves $\log \rho = f(1000)/T$ is a non-linear function. $\log \rho = f(\log \eta)$ is a linear function. Discontinuities were discovered in the $\log \rho = f(1000)/T$ curve. The portion of the curve at temperatures below the discontinuity, *i.e.* in the amorphous state, coincides with, and is an extension of the curve representing $\log \rho = f(1000)/T$ in the crystalline state. An explanation of this phenomenon, derived from general concepts of the structure of glass, is proposed. A concept of the relaxation mechanism of conductivity in liquids is introduced. AUTHORS.

See also Abstracts 1889, 1893, 2160, 2264, 2276.

DIELECTRICS AND CAPACITANCE.

2226. High Dielectric Constants. F. C. Frank. *Faraday Soc., Trans.* **33.** *pp.* **513–523,** *April,* **1937.**—The principal effects of chemical constitution upon dielectric properties are discussed in an attempt to attain an understanding of the causes determining the dielectric constants of materials, and especially the outstandingly large values found for certain substances. It is pointed out that the Clausius-Mossotti-Lorentz relation, which is taken as basic, automatically leads to very great disparity among the materials of largest dielectric constant, so that the occurrence of a few materials with dielectric constants greater than 100, while the vast majority are less than 10, is less in need of special explanation than might at first appear. It is shown that, among substances which are ionised or considerable as composed of ions, the chief criterion of high dielectric constant is a high ratio of ionic refraction to ionic volume; available measured quantities which can be used as a first guide. The effect of atomic array is the chief of the other determining factors which is dealt with. Attention is also given to the temperature coefficient of dielectric constant and the incidence of electronic semiconduction, which chiefly limits the usefulness of many solids of high dielectric constant, as electrolytic conduction limits that of liquids. AUTHOR.

2227. Dipole Moment and Structure of Some Cyclic Anhydrides. M. A. G. Rau and N. Anantanarayanan. *Indian Acad. Sci., Proc.* 5*A*. *pp*. 185–192, *Feb.*, 1937.—The moments of phthalic, citraconic and succinic anhydrides are measured, the first two in benzene as solvent and the last in dioxane. The values at 20° C. are respectively 5·25, 4·27, and $4\cdot20 \times 10^{-18}$ e.s.u., and are very high compared with those of the moments of the corresponding compounds phthalic and succinic imides. The moments are interpreted as due to a strong resonance structure, which reverses the normal direction of moment to be expected from vectorial addition. AUTHORS.

2228. Dipole Moment of 2, 4-Dichlorophenol. Cheng E. Sun and Chün Liu. *Chinese Chem. Soc., J.* 5. *pp*. 39–40, *March*, 1937.—*In English.*—The dipole moment of 2,4-dichlorophenol is calculated to be $\mu = 0\cdot0127 \times 10^{-18} \sqrt{(P_\infty - P_0)T}$, which gives the value 1·59 D. [See Abstract 873 (1937).] AUTHORS.

2229. Dipole Loss in Alcohols. W. Hackel. *Phys. Zeits.* 38. *pp*. 195–199, *March* 15, 1937.—The relaxation times of the molecules are determined for three alcohols from measurements of dielectric constant, conductivity and refractive index at various temperatures and frequencies. These values of relaxation time are always smaller than those calculated by means of the simple dipole theory. On the assumption of a quasi-crystalline structure for polar liquids, Debye has shown that the calculated values are now reduced, but the author shows that the corrected values are not in agreement with the values determined experimentally for two of the alcohols, *viz.*, propylalcohol and butylalcohol. E. R.

2230. H.F. Absorption in Alcohols. R. Zouckermann and R. Freymann. *J. de Physique et le Radium*, 8. *pp*. 103–110, *March*, 1937.—A thermal method of measuring h.f. absorption in liquid dielectrics is described. The liquid is contained in a calibrated thermometer, the reservoir of which lies in the electric field, and the rise of the column of liquid in the stem is observed photographically. Measurements are made by this means on pure alcohols, and it is shown that for the same frequency, the absorption ceases to increase for molecules containing more than 4 carbon atoms. E. R.

2231. Effect of CCl_4 Vapour on the Dielectric Strength of Air. M. T. Rodine and R. G. Herb. *Phys. Rev.* 51. *pp*. 508–511, *March* 15, 1937.—The effect of CCl_4 vapour on the dielectric strength of air is studied at a number of different air pressures up to a maximum of 75 lb./in.^{2}, With air at 25° C. and 15 lb. pressure the dielectric strengths of the mixtures relative to pure air ranged from a value of 1·25 for a CCl_4 vapour pressure of 5 % of saturation to a value of 1·80 for a saturated vapour pressure. At higher air pressures the addition of CCl_4 vapour gives a greater increase in the absolute value of the dielectric strength, but the percentage increase, relative to the pure air, is less than at 15 lb. pressure. AUTHORS.

See also Abstracts 1888, 1917, 2204, 2242, 2251.

ELECTROCHEMISTRY.

2232. Activity Coefficients from Concentration-Cell Potentials. T. Shedlovsky and D. A. MacInnes. *Am. Chem. Soc., J.* 59. *pp.* 503–506, *March*, 1937.—The activity coefficients in aqueous solution at 25° of KCl from C = 0·005 to 3·00 mol./l., and of $CaCl_2$ from C = 0·002 to 0·1 are determined from measurements of potentials of concentration cells with transference, and accurate transference numbers. It is found that the simple Debye-Hückel equation $-\log f_r = \alpha\sqrt{C}/(1+\beta\sqrt{C})$ fits the data, with high precision to C = 0·2 for KCl and to C = 0·03 for $CaCl_2$, with distances of closest approach of 4·1 and 52· Å, respectively. The equation $-\log f_r = (0{\cdot}5056\sqrt{C}\ (1+1{\cdot}50\sqrt{C}) - 0{\cdot}0365C \log C$ holds for KCl up to $C = 3{\cdot}00$, and the expression $-\log f_r = 1{\cdot}7515\sqrt{C}\ (1+2{\cdot}814\sqrt{C}) - 0{\cdot}147\ C$ fits the data for $CaCl_2$ up to $C = 0{\cdot}1$. [See also Abstract 5675 (1936).] AUTHORS.

2233. Electrolytic Oxidation of Sodium Arsenite. O. W. Brown, J. E. Hatfield and J. M. Church. *Am. Electrochem. Soc., Trans.* 70. *pp.* 323–325; *Disc.*, 325, 1936.—In place of the iron anodes used in the past for the electrolytic oxidation of sodium arsenite, the use of graphite and Pt anodes is investigated. It is found that a higher current efficiency and material yield is obtained with Acheson graphite anodes than with Pt anodes under the same conditions. The best electrolyte is an alkaline bicarbonate solution of As_2O_3. It is found, further, that upon increasing the concentration of As_2O_3 in the alkaline bicarbonate electrolyte, the current efficiency and material yield increase, attaining 100 % current efficiency when the As_2O_3 concentration is 8 %. Further increase in As_2O_3 concentration beyond 8 % has little if any effect on the current efficiency. AUTHORS.

2234. Electrolysis of Aqueous Solutions of Sodium and Zirconyl Sulphates. W. E. Bradt and H. B. Linford. *Am. Electrochem. Soc., Trans.* 70. *pp.* 431–439; *Disc.*, 440, 1936.—Aqueous solutions of sodium and zirconyl sulphates were electrolysed under controlled conditions. Difficulties due to the hydrolysis of zirconyl sulphate were partially avoided by the addition of Na_2SO_4. Factors investigated were: concentration of zirconyl sulphate, concentration of sodium sulphate, H-ion concentration, current density and temperature of electrolyte. Electrodeposited metallic Zr was obtained in two forms. One is a silver-white, compact, adherent metal similar to nickel electroplate in appearance. This slowly changes to the other modification which appears to be a non-adherent aggregation composed of a black powder which may be *Zr* or some oxidation product of Zr. Conditions are described for obtaining thin deposits of compact bright metal. AUTHORS.

2235. Electrolytic Deposition of Thin Layers of Titanium. M. Haïssinsky and H. Emmanuel-Zavizziano. *Comptes Rendus*, 204. *pp.* 759–761, *March* 8, 1937.—A solution of TiO_2 in H_2SO_4, of pH

1·2–1·6 and containing 1·7–2 mg./cc. TiO_2 with about 80–90 times that amount of $Na_2SO_4 \cdot 10H_2O$ is electrolysed with a Pb kathode, Pt anode and current 15·20 mA/cm.². A thin black coating of Ti is deposited containing 0·1—0·2 mg./cm.² A stronger current precipitates Ti hydroxide. Electrodes of Zn or Sb behave similarly, but with Ni or Pt no Ti is deposited. With a Pb kathode the kathode potential decreases from − 1·34 V with a current of 15 mA/cm.² to − 0·94 V after 24 hrs. With Pt or Ni the initial potential is <1 V. [See Abstract 4347 (1936).] C. A. S.

2236. Electrolytic Separation of Hydrogen Isotopes on a Palladium Kathode. A. Farkas. *Faraday Soc., Trans.* 33. *pp.* 552–559, *April,* 1937.—Using a Pd kathode, the electrolysis of mixtures of H_2O and D_2O has been carried out in alkaline and acid solutions. The D content of the evolved gas has been compared with that of the gas occluded in the kathode and the following separation factors found $(H/D)_{occl.}/(H/D)_{sol.} = 6 \cdot 6$, $(H/D)_{evolv.}/(H/D)_{sol.} = 4 \cdot 4$. It is shown that the separation factor 6·6 can be regarded as caused by the establishment of the equilibrium $MH + HDO = MD + H_2O$ on the electrode (M), in agreement with the theory proposed by Halpern and Gross. On the other hand, the difference in the separation factors 6·6 and 4·4 is to be attributed to a different rate of recombination of H and D atoms on the Pd. AUTHOR.

2237. Preparation of Nitric Esters by Electrolysis. V. Öhman. *Zeits. f. Elektrochem.* 43. *pp.* 263–264, *April,* 1937.—A correction. [See Abstract 359 (1937).]

***2238. Electrolysis of Fatty Acids Containing Deuterium. Part I. P. Hölemann and K. Clusius.** *Zeits. f. phys. Chem.* 35. *Abt. B.* 4. *pp.* 261–269, 1937.—D-acetic acid is electrolysed in ordinary water and ordinary acetic acid in heavy water. The analysis apparatus and a micro-suspension balance to determine the density of the evolved ethane are described. The composition of the ethane evolved depends only on the constitution of the acetate ions so that by the electrolysis of D-acetic acid in light water pure C_2D_6 is evolved. There is thus no exchange of H atoms between the intermediate methyl radicals and the solvent. J. K.

2239. Transport of Ions in Presence of Colloids. J. J. Bikerman. *Faraday Soc., Trans.* 33. *pp.* 560–564, *April,* 1937.—The mobility of NH_4-ions in presence of colloidal As_2S_3 is measured. The observed retardation is discussed from the points of view both of exchange adsorption and of the diffuse double layer. AUTHOR.

2240. Comparison of Hydrogen, Quinhydrone and Glass Electrodes. E. S. Amis and J. L. Gabbard. *Am. Chem. Soc., J.* 59. *pp.* 557–561, *March,* 1937.—It is shown that the presence of Mg-ions to the extent of 2mol./l. does not affect the potential of the glass electrode. The water error of the glass electrode in $MgSO_4$ solutions is found to conform well with the equation derived by Dole. It is shown that the glass electrode is suitable for measuring the "salt error" of the quinhydrone electrode in solutions buffered with only traces of HCl, and that this error depends upon the pH of the solution. AUTHORS.

2241. Electrode Potentials of Lithium, Rubidium and Calcium in Liquid Ammonia. W. A. Pleskow. *Acta Physicochimica,* 6. 1. *pp.* 1–10, 1937. *In German.*—The electrode potentials of Li, Rb and Ca are determined by measurement of the potentials of amalgams of these metals in liquid NH_3. The normal electrode used for these determinations consists of a freshly cut lead electrode in a 0·1 *N*. solution of $Pb(NO_3)_2$ in liquid NH_3. The measurements are carried out in a bath filled with liquid NH_3 and maintained at a temperature of $-35{\cdot}0° \pm 0{\cdot}1°$ C.

F. J. B.

2242. Capacity of a Bright Platinum Electrode in Various Electrolytes. B. Ershler and M. Proskurnin. *Acta Physicochimica*, 6. 2. *pp*. 195–204, 1937. *In English*.—It is shown that the capacity of the bright Pt electrode depends very greatly on the purity of the solution and on the previous treatment of the electrode. Heating in H_2 gives an electrode having a small capacity in the H_2 region. The influence of the composition of the electrolyte on the shape of the capacity curve of the bright Pt electrode is similar to that observed in the case of the platinised electrode. The difference between the curves of the bright and platinised Pt electrodes is essentially pronounced in the O_2 region; it can be explained probably by the slowness of the process of deposition and removal of O_2. A new method of measuring the capacity of the bright Pt electrode is described. AUTHORS.

See also Abstracts 1867, 2224.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

2243. Scattering of Kathode Rays in Gases. A. Becker and E. Kipphan. *Ann. d. Physik*, 28. 6. *pp*. 465–506, *March*, 1937.—A sharply defined beam of kathode rays of voltages from 20 to 80 k.v. is directed into two measuring chambers containing gases at low pressures. By means of a series of graduated slits it is possible to estimate the spread of the beam and hence the diffusion of the electrons. The gases used ranged from H_2 to EtI (mol. wt. 156). The effects of gas pressure, nature of gas, and electron velocity on the scattering were investigated. For most gases it is shown that the electron intensity i_p in the gas filled collecting chamber is related to the corresponding "vacuum" intensity by the formula $(1/pV^2) \log (i_o/i_p) \sim Q_d$, when the pressure is below 1 mm. Hg. It is suggested that the constant Q_d can be regarded as a "diffusion cross-section" for each gas used. The product Q_dV^2 increases in general with gas density, but no rule is established. Theoretical investigations on a basis of single scattering indicate that $(i_o - i_p)V^2/pi_o =$ const. and for the lighter gases at low pressures this is shown to be true. When higher pressures are used these formulæ break down, and an attempt is made to correlate the results with the formula $i_p/i_o = 1 - \epsilon^{-m/p}$, obtained from the theory of multiple scattering. The agreement in these cases is not satisfactory. J. E. R.

2244. Double Scattering of Fast Electrons. H. Richter. *Ann. d. Physik*, 28. 6. *pp*. 533–554, *March*, 1937.—The double scattering of electrons of 20–120 ekV energy at 90° by Al and Ag foils is examined. Foils of thickness $3–6 \times 10^{-6}$ cm. were used and the angular distribution of the scattered electrons obeyed Rutherford's law for single scattering. In contradiction to Mott's theory which predicts a polarisation of 16 % with the Ag foils, no polarisation was found in either case. F. C. C.

***2245. Variation of Secondary Electron Emission from Metals with Angle of Incidence of Primary Electrons. H. O. Müller.** *Zeits. f. Physik*, 104. 7–8. *pp*. 475–486, 1937.—Apparatus is described in which a beam of kathode rays of variable voltage can be directed at targets of Ni, Al, Mo, W, Cu and C, at various angles, and the secondary electron emission measured. It is shown that as the angle of incidence of the kathode rays increases, the secondary emission increases in all cases. Previous measurements of secondary emission using perpendicular incidence of the primary beam at varying voltages were confirmed for all other incidence angles. The number of electrons emitted is shown to follow the law $s = B/\cos\alpha$ to a first approximation ; a correction must be made for the scattering of the primary rays in the metal. No estimate can yet be made of the absolute value of the secondary emission, largely owing to lack of knowledge of the effect of the density of the scattering block. J. E. R.

2246. Eight Third-Order Aberrations of Magnetic Electron Lenses. K. Diels and G. Wendt. *Zeits. f. techn. Physik,* 18. 3. *pp.* 65–69, 1937.—Experiments are described with a kathode-ray tube having electromagnetic beam focusing which permit isolation and illustration of the characteristics of the eight third-order aberrations of the anisotropic magnetic electron lens, namely, spherical aberration, isotropic and anisotropic coma, astigmatism and image curvature, anisotropic image curvature, isotropic and anisotropic image distortion. J. E. K.

2247. Positron Emission. K. Shinohara. *Inst. Phys. and Chem Research, Tokyo, Sci. Papers, No.* 685. *pp.* 174–186, *March,* 1937. *In English.*—The intense emissions of natural positrons from RaC and Th (B + C) are confirmed by using the trochoidal focusing method. Expressing as the ratio with the number of electrons emitted, the values obtained were $4{\cdot}7 \times 10^{-4}$ and $4{\cdot}2 \times 10^{-4}$ respectively. The numbers of positrons emitted from a thick piece of lead by pair production by γ-rays. were also estimated. These were 1·0 and 2·2 times of those of positrons from the source of RaC and Th(B + C) respectively. AUTHOR.

2248. Space Charge Equation for Electrons with Initial Velocity. Part II. W. Kleen and H. Rothe. *Zeits. f. Physik,* 104. 11–12. *pp.* 711–723, 1937.—Current/voltage characteristics are calculated for a plane parallel electrode system into which electrons enter with initial velocities normal to the electrodes. It is found that formation and dispersal of virtual kathodes are connected with sudden changes of the current or potential distribution. The characteristics display regions of negative resistance of light arc or dynatron character. [For Part I see Abstract 4367 (1936)]. J. E. K.

See also Abstracts 1891, 1903, 1904, 1905, 1906, 2052, 2056, 2087, 2149.

ELECTROSTATICS.

2249. Effect of Heat Treatment on the Triboelectric Properties of Quartz and of Metals. P. A. Mainstone. *Phil. Mag.* 23. *pp.* 620–628, *April,* 1937.—The triboelectric property of quartz is normally positive with respect to most metals. After heating at temperatures above 350° C., and at a pressure of 10^{-4} mm., it becomes electrically negative. The technique employed for the removal of impurities during heating has failed to prevent this reversal. The metals Sn, Bi, Zn, Al, when heated almost to their respective melting-points, and the metals Cu, Ni, Pd, when heated to 800° C., show no reversal of their triboelectric properties. AUTHOR.

2250. Triboelectric Properties of a Quartz-Nickel Interface. P. A. Mainstone. *Phil. Mag.* 23. *pp.* 702–708, *April,* 1937. *Supplement.*—The frictional charges produced on a Ni surface by the passage of a

quartz rubber are measured at temperatures 120° C., 15° C., and − 78° C. In atmospheres of both air and H_2 the charges at the three temperatures in the order given are in increasing order of magnitude at gas pressures of 60 cm. and 5 cm. At pressures of 1 mm. and 10^{-4} mm. the charges are irregular and bear no relation to the temperature. The results are discussed in the light of available figures for the amounts of gases adsorbed by Ni. The unknown adsorption by the quartz is, however, a complicating factor.
AUTHOR.

2251. Charge Potential of Insulators Irradiated by Electrons. C. Hagen and H. Bey. *Zeits. f. Physik*, **104.** 9–10. *pp.* 681–684, 1937.—The potential of insulators when irradiated by electrons in high vacuum tubes, is determined when the anode potential is varied. At low anode voltages (less than 100 V) the insulator potential is zero. When the anode voltage is further increased, the insulator potential increases until a point is reached when subsequent increase of anode voltage causes no increase in the insulator potential, due to the fact that the secondary emission is equal to the primary emission. These results on insulators such as glass, zinc silicate, etc., are very similar to those obtained on metal plates. E. R.

See also Abstracts 1876, 2162, 2219.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2252. Galvanomagnetic Phenomena in Thin Metallic Pellicles. C. Bellia. *N. Cimento*, **13.** *pp.* 441–450, *Dec.*, 1936.—Thin pellicles of Bi obtained by kathodic sputtering were investigated and it was found that, contrary to that which occurs in relatively thick sheets obtained by fusion, in the pellicles the electrical resistance and the coefficient of the Hall effect do not change on variation of the magnetic field. Moreover pellicles of Sb, Te, and Ni were found not to show any variation of electrical resistance through action of the magnetic field. These phenomena must be attributed to the amorphous condition of the pellicles because on remelting the pellicles of Bi so as to reduce them to the crystalline state it was observed that both the increase of resistance through action of the magnetic field and the variation of the coefficient of the Hall effect were altered by the field. The results are discussed on the basis of the electronic theory of metals. J. J. S.

2253. Increase of Electrical Resistance in a Magnetic Field: Diamagnetism. W. J. de Haas and J. W. Blom. *K. Onnes Lab., Leiden, Comm. Nos.* 241–252, *Suppt. No.* 82*c.* [19 *pp.*], 1936. *In French.*—Determination has been made of $\Delta R_H/R_{0^\circ C}$ for a group of metals, where ΔR_H is the increase of resistance in a magnetic field and $R_{0^\circ C}$ is the resistance at 0° C. without field. ΔR_H has been determined specially for Bi, Ga, graphite, Sb, and the alloy *Zn–Cu*, of which the diamagnetic susceptibility is very great. The experiments have been continued down to the temperature of liquid He, with a monocrystal of Bi which had the principal axis parallel to the length; σ_1 and ΔR_1 both depend strongly on the angle α between the magnetic field and one of the binary axes, and this dependence becomes very complicated, and shows relative maxima and minima which appear very pronounced in the diagrams exhibiting $R_H/R_{0^\circ C}$ as a function of α, as well as in the variation of σ_1 and of ΔR_1 with the magnetic field. For Ga a monocrystal was prepared which had the pseudo-tetragonal axis (*i.e.* the longest axis) parallel to the length of the crystal and details are given of the experiments on this crystal, which were confined to temperatures of liquid N_2. Further experiments on the metals mentioned are described and the results are shown on numerous diagrams. The paper concludes with a comparison of the results with various theories. J. J. S.

See also Abstract 2258.

MAGNETISM AND ELECTROMAGNETISM.

2254. Theory of Ferromagnetism. H. A. Kramers. *K. Onnes Lab., Leiden, Comm. Nos.* 241–252. *Suppt. No.* 83. [22 *pp.*], 1936. *In German.*—A new method is given for calculating the condition-sum for a system with limited variation of energy. It is applied to the case of the ferromagnetic model of Heisenberg, and gives, for very high and very low temperatures, the Heisenberg and Bloch results. G. E. A.

2255. Magnetic Properties of Rare Metals. F. Trombe. *Ann. de Physique,* 7. *pp.* 385–419, *March,* 1937.—The metals La, Ce and Nd are not ferromagnetic. La is feebly paramagnetic, and becomes less magnetic with rise of temperature. At 16° C. its susceptibility χ is $1\cdot9 \times 10^{-6}$, and that of Ce $17\cdot6 \times 10^{-6}$. The latter element has complicated magnetic properties at low temperatures and appears to exist in two magnetic states which are reversible and possess a certain inertia. Nd follows the Weiss law between air temperature and 109° K. Its moment is 17·8 Weiss magnetons, nearly the same as that of its salts (17·9) and the theoretical moment (18) of the ion Nd+++. The Curie point for this metal is + 10° K. Salts of Gd are strongly paramagnetic, and obey the Weiss law. The magnetic moment of the oxide Gd_2O_3 is 39·25, and the Curie point −18·4°. The metal Gd has a Curie point at 16° C, and is strongly ferromagnetic at low temperatures. At 0° K the specific magnetisation (253·5) of Gd is higher than that of Fe (221·7); the respective atomic moments are 35·4 and 11. Above its Curie point Gd is paramagnetic and follows the Weiss law between 90° and 366° C. Its moment (39·28) is almost the same as that of the oxide, and that of the ion Gd+++ (39·26). The atomic moment of ferromagnetic Gd (35·4) is due to seven spin moments of the electrons in the deepest orbit which are the cause of the ferromagnetism. The ferromagnetic property may now be regarded as belonging also to the rare-earth family of the periodic system. G. E. A.

2256. Magnetic Properties of Fe–Zn Alloys. M. Fallot. *Ann. de Physique,* 7. *pp.* 420–428, *March,* 1937.—Alloys of Fe with Zn were prepared with a Zn content ranging from 0 to 17 %. Fusion took place under pressure. The Curie point temperatures for the series decrease at the rate of 6° C per atom of Zn added per cent. The mean ferromagnetic moment of the alloy diminishes as the Zn content increases. It is calculated that the compound Fe_2FeZn has a mean moment of 8·52 Weiss magnetons per atom, or a total for the four atoms of 34·08. If this moment is due entirely to the Fe atoms, these have each a moment 11·36. The mean moment of the Fe atom is therefore increased in consequence of the presence of Zn in the Fe lattice. G. E. A.

2257. Discontinuities of Magnetisation in Alternating Field. Explanation of Multiple Frequencies which appear with Ferro-Resonance. S. Procopiu and G. Vasiliu. *Comptes Rendus,* 204. *pp.* 673–674, *March* 1, 1937.—When a.c. is passed through an Fe or Ni wire, inductive effects are produced in a coil surrounding the wire. These are due to discontinuities of magnetisation which take place when the axial current strength I exceeds the value for which the field $2I/10r$ is equal to the coercive force of the material of the wire of radius r. The authors have studied the effect with the aid of an amplifier and oscillograph. Discontinuities of magnetisation were observed for current maxima and minima, and the induced current has double the frequency of the axial current. With a stretched wire the discontinuity is increased in Ni and diminished in Fe. Similar effects are observed when the wire is magnetised transversely. It is concluded that the Fe or Ni by means of these magnetic changes is the origin of all the harmonics which appear in a circuit containing a coil with an iron core. G. E. A.

2258. Calculation of Temperature Coefficient of Magnet. J. R. Ashworth. *Phil. Mag.* 23. *pp.* 355–360, *March,* 1937.—A formula for the temperature coefficient of a magnet was derived by the author by applying van der Waals' equation of state. It was given in terms of the reduced intensity of magnetisation and the critical temperature in °Abs. It is now rewritten in terms of reduced temperatures and is applicable to any temperature up to the critical temperature. The calculated results are in agreement with those of experiment. H. J. H. S.

2259. Magnetic Susceptibility of Metallic Cerium and Praseodymium. L. F. Wereschtschagin, L. W. Schubnikow, and B. G. Lasarew. *Phys. Zeits. d. Sowjetunion,* 10. 5. *pp.* 618–624, 1936. *In German.*—Drojjina and Janus have found that the magnetic susceptibility of the metals Ce and Pr in the temperature region of 90° to 376° Abs. obeys exactly the law of Curie-Weiss; thus it was found that for Ce $p = 11 \cdot 4$ Mw and $\Theta = 6°$ K, and for Pr $p = 16 \cdot 0$ Mw and $\Theta = 2$. Using the same pure preparations from the U.S.A. that were employed by Janus and Drojjina the authors have made measurements at lower temperatures. It was found that, contrary to the results of Janus and Drojjina, the susceptibility depends on the strength of field. Measurements in fields of 4545 and 6195 gauss showed, however, that in these fields the susceptibility attained saturation, and is independent of the field strength. The dependence of the susceptibility on the magnetic field is considered to be due to bye-products in the preparation, probably free Fe, but not to the extent of more than 0·01 %. Thus the susceptibility of metallic Ce does not follow the law of Curie-Weiss. Janus and Drojjina did not detect this owing to their use of weak fields. The magnetic moment was found to be 11·1 Mw. For Pr no dependence on the field strength could be found. Measurements were made at temperatures down to 14·0 K. The magnetic moment of Pr amounts to 16·1 Mw. J. J. S.

2260. Magnetic Susceptibility and Grain Size of Powdered Hematite. R. Chevalier and Suzanne Mathieu. *Comptes Rendus,* 204. *pp.* 854–856, *March* 15, 1937.—Rhombohedral crystal powders of ferric oxide have very variable mass susceptibilities. The value of χ varies between 20 and 150×10^{-6} for artificial oxides, and between 100 and 500×10^{-6} for powdered hematites. It is known that the increase in the susceptibility of ferric oxide due to heating is accompanied by increase in the size of the grains. Measurements on hematites show that χ has a value of the order 300 to 400×10^{-6} for a coarse powder, and that this is reduced to 25×10^{-6} after powdering for ½ hr. The method of obtaining the powders is described, and a table is given, for three hematites from different sources, of the values of χ for grain sizes which vary from 500 to 10μ. The diminution of χ with size of grain is at first slow, but becomes much more rapid, tending to a limiting value 25×10^{-6} for zero size. This agrees with the minimum value for artificial Fe_2O_3 powders. Although χ varies with the size of grain it depends also on some other variable, since one of the hematites had, throughout, a higher value than the other two. G. E. A.

2261. Diamagnetic Susceptibilities of Salts Forming Ions with Inert Gas Configurations. Part III. Alkaline Earth Halides and General Discussion. F. E. Hoare and G. W. Brindley. *Roy. Soc., Proc.* 159*A*. *pp.* 395–409, *April* 1, 1937.—In continuation of previous work [see Abstract 5233 (1935)] the susceptibilities of halides of Mg, Ca, Sr and Ba are measured and tabulated. For most ions the susceptibility appears to be less in the crystalline state than in the free state; this is more marked for negative ions than for positive ones. With negative ions also the susceptibilities decrease progressively as the number of surrounding ions (coordination number) increases. There is no simple connection between ionic susceptibilities and ionic packing radii which are used for coordinating the observed interatomic distances. G. E. A.

2262. General Motion of a Spinning Uniformly and Rigidly Electrified Sphere. Part III. G. A. Schott. *Roy. Soc., Proc.* 159*A*. *pp.* 548–570, *April* 15, 1937.—The method used in Part I and II [see Abstract 4884 (1936)] for determining the electromagnetic field of a rigidly and uniformly electrified sphere in translatory motion and its mechanical reaction on the sphere is improved and generalised so as to include the effects of spin. Expressions in the form of single definite integrals as before are found for the force and couple constituents of the total mechanical reaction, and these are specialised for the case in which the centre of the sphere describes any plane curve with speed less than that of light, whilst the sphere spins about an axis always normal to the plane of the orbit of its centre. The limits of the integrals are found to depend on the orbital motion alone and not at all on the spin, which remains unrestricted in magnitude, so that the resultant velocities of points on the surface of the sphere can very well exceed the speed of light. In general the uniplanar motion is determined by three equations of motion indissolubly coupled together, so that the orbital motion of the centre and the spin cannot be treated separately as in classical mechanics, apart from exceptional cases. For the general motion six equations of motion are required as usual, but again these are indissolubly coupled together, so that an electrified body behaves in this respect more like a rigid body moving through liquid than the unconstrained rigid body of classical rigid dynamics. [See following Abstract].

AUTHOR.

2263. Uniform Circular Motion with Invariable Normal Spin of a Rigidly and Uniformly Electrified Sphere. Part IV. G. A. Schott. *Roy. Soc., Proc.* 159*A*. *pp.* 570–591, *April* 15, 1937.—The general formulæ of Part III [see preceding Abstract] are applied to the special case in which the centre of the sphere moves in a circle of radius R with the uniform speed $c\beta$ less than that of light, whilst the sphere spins about a diameter normal to the plane of the circle with an invariable angular velocity pc/a unrestricted in magnitude. The force constituents of the total mechanical reaction, both tangential and radial, are found to be quadratic polynomials in p with coefficients depending on β and R, whilst the couple constituent is linear. In this particular case the coefficients in the expression for the couple are found to vanish identically for all values of β and R, so that to this extent the spin is arbitrary, and there can be no external couple—a property probably peculiar to uniform motion in a circle. All the coefficients in the expressions for the force constituents are expansible in Kepler-Bessel series of sines and cosines of integral multiples of $\beta a/R$ with coefficients derived from Bessel functions of corresponding integral multiples of β. Consequently both the tangential and normal force constituents vanish when $\beta a/R$ is an integral multiple of π, so that we obtain families of stationary orbits, for each of which there is no radiation, no spin and no transverse electromagnetic mass, whilst the radius of the circular orbit is less than a/π, the speed can approach that of light, and the acceleration is central and very large, all results being consistent with rigorously developed classical electrodynamics, but contradicting widely accepted opinions. The case of small speeds and comparatively large circular orbits is also investigated approximately; the radiation in the absence of spin is found to agree with the classical result of a point-charge, but can be reduced much below this value by a suitable spin. In all cases the radiation can never become negative, though it can have zero as a minimum value. AUTHOR.

***2264. Models to Illustrate Gyromagnetic and Electron-Inertia Effects. S. J. Barnett.** *Am. Physics Teacher*, 5. *pp.* 1–6, *Feb.*, 1937.—A number of simple models are described to illustrate magnetisation by rotation and its converse as well as certain electron-inertia effects in metallic conduction. [See also Abstract 2754 (1935)]. H. J. H. S.

See also Abstracts 2031, 2170, 2219.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2265. Strength-Duration Curves and the Theory of Electrical Excitation. W. J. Crozier. *Nat. Acad. Sci., Proc.* 23. *pp.* 71–78, *Feb.*, 1937.—Measurements on the relations of current strength and time for a fixed magnitude of effect due to repetitive electrical excitation in nerve and muscle are found to be described well by a logarithmic probability integral. A similar relationship appears in stimulation by light and sound. The value of the time for which $100\, C_0/C = 50\,\%$, where C_0 is the asymptotic lower exciting curve is essentially the chronaxie. The log. probability integral gives a suitable means of comparing different forms of excitability. G. E. B.

***2266. Improved Triple-Electrocardiography. H. E. Hollmann.** *Zeits. f. Instrumentenk.* 57. *pp.* 117–124, *March*, 1937.—A detailed description is given of the various circuits used in which the "action currents" produced from cardiac rhythms from three contacts taken in pairs (1) right arm—left arm, (2) right arm—left leg, (3) left arm—left leg, which have hitherto been detected by an Einthoven string galvanometer, are now amplified by thermionic valves and recorded on kathode-ray oscillographs. A number of circuit arrangements are given for obtaining either, three direct records, or a record in which the third is made the differential of the first two, which are direct, together with a 50∼time base. The methods of protecting the apparatus from external electrical interference are discussed, and examples of the resulting electrocardiograms are given. T. A. C.

***2267. Modified Standard Ionisation Chamber System. E. Dershem, L. E. Rovner and S. P. Perry.** *Am. J. of Roentgenology and Radium Therapy*, 37. *pp.* 242–246, *Feb.*, 1937.—Air ionisation chambers have been developed to a degree to permit accurate measurement of intensity of X-rays up to 200kV. The authors describe in detail with illustration, such a chamber of improved design in which standard condensers and an electrometer are incorporated, the theory of these standardising condensers being dealt with theoretically, together with the methods employed to calibrate less accurate thimble instruments by means of the standard instrument. B. J. L.

***2268. Protective Factors in the Preparation and Handling of Gold Implants and Other Radon Applicators. W. Stenstrom and C. E. Nurnberger.** *Am. J. of Roentgenology and Radium Therapy*, 37. *pp*. 247–253, *Feb*., 1937.—Danger to personnel handling radon and radium is well known and safety is dependent upon instruction and satisfactory apparatus. Apparatus to obtain emanation is described which has the advantage of reducing the time for collection, so reducing the time of exposure of the operator, as well as saving considerable quantities of radon which has been lost by older methods. Lead-protected carriers with long handles have been constructed for the transport of radium and radon applicators and a semi-automatic implant cutter also provide protection. These implants are then measured and sorted by a further apparatus permitting manipulation by the operator from a distance and giving greater speed of operation. Finally a lead wagon for transport of radium and radon applicators in hospital routine use is described. By means of a " proteximeter " ionisation chamber carried in the operator's vest pocket measurements have been made of the actual doses received by the operators. B. J. L.

2269. High-Density Alloys for Radium Containers. C. J. Smithells. *Nature*, 139. *pp*. 490–491, *March* 20, 1937.—By use of W instead of Pb for Ra bombs a considerable reduction in size may be attained without sacrificing protection against the harmful γ-radiation. However, no means are available for sintering W masses of about 1 cwt. in size at 3000° C. and the metal is almost unmachinable. On heating W powder in contact with Cu or Co the particles are wetted, shrinkage occurs, and the finished alloy has a density of 16·3–16·5 against 11·35 for Pb. W powder is mixed with 5–10 % of Co or Cu powders, or both, compressed in a steel die and heated in H_2 at 1450° C. for 1 hr. Cu melts at 1084° and the W-Ni eutectic at about 1400° C., and a shrinkage of 20 % linear occurs. The microstructure shows W particles embedded in a matrix of Cu, Cu-Ni or Ni-W eutectic, the tensile strength is about 22 tons/in.^{2}, and the alloys may be hot-worked but are non-ductile. They may be machined without difficulty with ordinary tools, for large surfaces widia tools are advantageous. Large bombs are best constructed from accurately machined annuli separated by 0·1 mm. Ni foil and heated in H_2 at 1450° C., when perfect welding occurs. Possible industrial applications are the balancing of crankshafts in internal combustion engines, gyroscopes, heavy duty circuit-breakers. Contacts of area 2 in.^{2} can handle 130,000 A at 6,000 V. D. R. H.

See also Abstracts 2052, 2212.

OSCILLATIONS AND WAVES.

***2270. Pentode-Operated Frequency Meter. E. L. E. Wheatcroft and G. Haley.** *Journ. Sci. Instruments*, 14. *pp*. 136–140, *April*, 1937.—A frequency meter is described having ranges of 0–150, 0–1500, 0–15000 $\sim$. The meter is of the condenser-charging type employing two pentode valves, and is "mains operated." The indication of frequency is correct within 1% for any input voltage greater than 0·3 V. r.m.s.

AUTHORS.

2271. Resonance Dispersion in Ionised Gases. W. Sigrist. *Helv. Phys. Acta*, 10. 2. *pp.* 73–106, 1937. *In German.*—The resonance dispersion of ionised gases observed by various workers is here shown to be a true electron resonance. Investigation of the dependence on amplitude of the resonance ion density shows clearly that the quasi-electric linkage of electrons is, in the case of the views regarding plasma oscillations developed by Langmuir, a macro-linkage. The phenomena in question can only be explained by inhomogeneous distribution of the ion density along the electric field vector. With this assumption a comprehensive explanation of the phenomena of resonance dispersion is possible. The assumption of a non-homogeneous distribution of ion density proves correct for gas discharges but is not fulfilled in the ionosphere. Resonance dispersion such as is here dealt with cannot therefore furnish any explanation of the reflection of electromagnetic waves in the ionosphere. A. W.

2272. Propagation of Waves of the Order of 10 m. and of Very Short Waves. P. Labat. *Onde Élec.* 16. *pp.* 200–203, *March*, 1937.—After a brief review of the part played by amateurs in the development of intercontinental communication on short wave-lengths, the results published by Stoye [see Abstract 399 (1937)] are discussed with particular reference to the effect of solar activity on the propagation of waves of about 10 m. wave-length. It is then suggested that amateurs, private societies and public services might all cooperate in the accumulation of data on the reception of wave-lengths from 10 m. downwards. A. W.

2273. Ionospheric Data. T. R. Gilliland, S. S. Kirby, N. Smith, and S. E. Reymer. *Terr. Mag.* 41. *pp.* 379–388, *Dec.*, 1936.—The paper gives in tabular form data on the critical frequencies and virtual heights of the ionosphere from May 1934 to Dec. 1936 in the form of monthly averages for each hour of the diurnal period. The data were obtained mainly with an automatic multi-frequency recorder covering the range 2·5 to 4·4 Mc./sec. These are supplemented by some manual observations and in the latter portion of the period by a fixed frequency recorder working at 7·25 and 6·2 Mc./sec. The long-time increase of critical frequencies for all regions of the ionosphere, which is believed to be associated with the 11-yr. sunspot-cycle, is stated to be the most interesting characteristic shown by these systematic observations. F. S. B.

2274. Relations Between Ionosphere Layers and Meteorological Influences. G. Leithäuser and B. Beckmann. *Zeits. f. techn. Physik*, 18. 3. *pp.* 59–61, 1937.—Investigations are described which show that the steepness of the rise of ionospheric layers which occurs towards evening is affected by the intensity of the high-altitude wind in the east to west direction. A number of curves taken during 1936 are given which all show this connection between steepness of rise and wind intensity very clearly, the two curves in general rising and falling together. The results show that a low value of the steepness angle is accompanied by a condition of the atmosphere which gives rise at a few km. height to a westerly air current. The cause of this is probably to be sought in the influence of the lower ionic region on the apparent height behaviour. [See also Abstract 5701 (1936).] A. W.

2275. Certain Features of Ionospheric Echoes. R. Jouaust, P. Abadie and H. Joigny. *Onde Élec.* 16. *pp.* 185–188, *March*, 1937.—Observations were made by Breit and Tuve's method of ionospheric echoes, using wave-lengths from 36 to 80 m. The echoes were observed in most cases visually, using a kathode-ray oscillograph. Multiple echoes were obtained in many cases and it was frequently found that the echo shape changed from a simple form to a double or triple form and back to the simple form again within a few seconds. These and other similar results tend to show that the ionosphere is in a perpetual state of variation both as regards the vertical and the horizontal direction. If dissociation of the echo is to be attributed to the terrestrial magetic field, certain results obtained would seem to indicate that the displacements of the ionised layers of the upper atmosphere are accompanied in that region by important variations of the terrestrial field, such variations being too localised to act on a magnetograph. A. W.

***2276. Voltage Stabiliser Circuit. J. A. Ashworth and J. C. Mouzon.** *Rev. Sci. Instruments,* 8. *pp.* 127–129, *April,* 1937.—A new voltage stabiliser circuit is described. The circuit is of the bridge type wherein an essentially constant current is maintained in the output resistor. The particular feature of the circuit is the elimination of transients in the output voltage due to changes in emission of the kathode of the type 78 stabiliser tube. A precision method for the variation and measurement of the output voltage is also described. AUTHORS.

See also Abstracts 2017, 2204.

PHOTOELECTRICITY.

2277. Photoelectric and Optical Properties of Zinc, Silver and Fuchsin. F. Hlučka. *Zeits. f. Physik,* 104. 9–10. *pp.* 653–657, 1937.—Supplementary to the author's former work [see Abstracts 170 and 210 (1937)] on the relation between photoelectric and optical anomalies, the region from the infra-red to the ultra-violet (230$\mu\mu$) has been studied. J. E.

2278. Soft X-Rays and Photoelectrons from Nickel at Different Temperatures. S. R. Rao. *Roy. Soc., Proc.* 159*A*. *pp.* 283–294, *March* 15, 1937.—The photoelectric efficiencies of Cu and Ni when exposed to soft X-radiation are found to be independent of temperature in the range 30–500° C. The soft X-ray intensity from polycrystalline Ni increases with temperature gradually at first and more rapidly at higher temperatures. No abrupt change in intensity is observed at the Curie point of Ni. A comparative study has been made of the photoelectric efficiences of polycrystalline Ni, a single crystal of Ni with 110 face and polycrystalline Cu. Attention is drawn to observations made by Tartakowsky and Kudrjawzewa and Hayakawa indicating an abrupt change in the secondary electron emission from Ni at the Curie point. These results are examined in the light of the theories of Richardson regarding the existence of structure electrons in metals and Heisenberg's theory of ferromagnetism. AUTHOR.

See also Abstract 2144.